Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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May 1949 . . . . . Vol. 21, No. 5

The Editor's Pages (news, notes, and comment)..... 69

"Open for Discussion" (a regular feature)..... 73

Piping, Heating and Ventilating North Western's New Diesel Shop, by H. P. Watson..... 77

Air Conditioned Plane Has Aluminum Compressors..... 82

How to Service Package Boilers, by Kalman Steiner..... 83

Basic Principles of Piping—a Review of Fundamentals, by Herman Vetter..... 87

Modern Thinking Applied to Duct Design, by Kirby Walker..... 91

Summary of Methods for Sterilizing Air, by Cyril Tasker..... 95

How to Design the Piping for Conveying Flashing Hot Water, by Theodore E. Bridge..... 98

Data Sheet—These Safety Rules Reduce On-the-Job Piping Injuries 101

Sam Lewis' Page—Train Ride Reminder of Wonders of Glass... 103

Question of the Month—Here's How to Service Air Conditioning Jobs, by Armand Cowan..... 105

What's Best Way to Evaporate Excess Water in Industrial Process? 107

Equipment Developments..... 205

Who's What..... 218

New Books and Reports..... 228

Meetings and Conventions..... 234

Recent Trade Literature..... 240

Index to Advertisers..... 250

Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc.

Journal Section of the American Society of Heating and Ventilating Engineers

Human Tolerance Limits for Extreme Heat, by W. V. Blockley and Craig L. Taylor..... 111

Earth as a Heat Source or Storage Medium for the Heat Pump, by E. W. Guernsey, P. L. Betz, and N. H. Skau..... 117

The Silicosis Problem in Ohio, by Lester M. Merritt..... 123

Technical Sessions and Social Functions Beckon Members to Minneapolis Meeting..... 127

Summary of Local Chapter Meetings..... 130

Latest Edition of Guide Is Largest..... 137

Candidates for Membership..... 143

Officers, Council, and Committees..... 147

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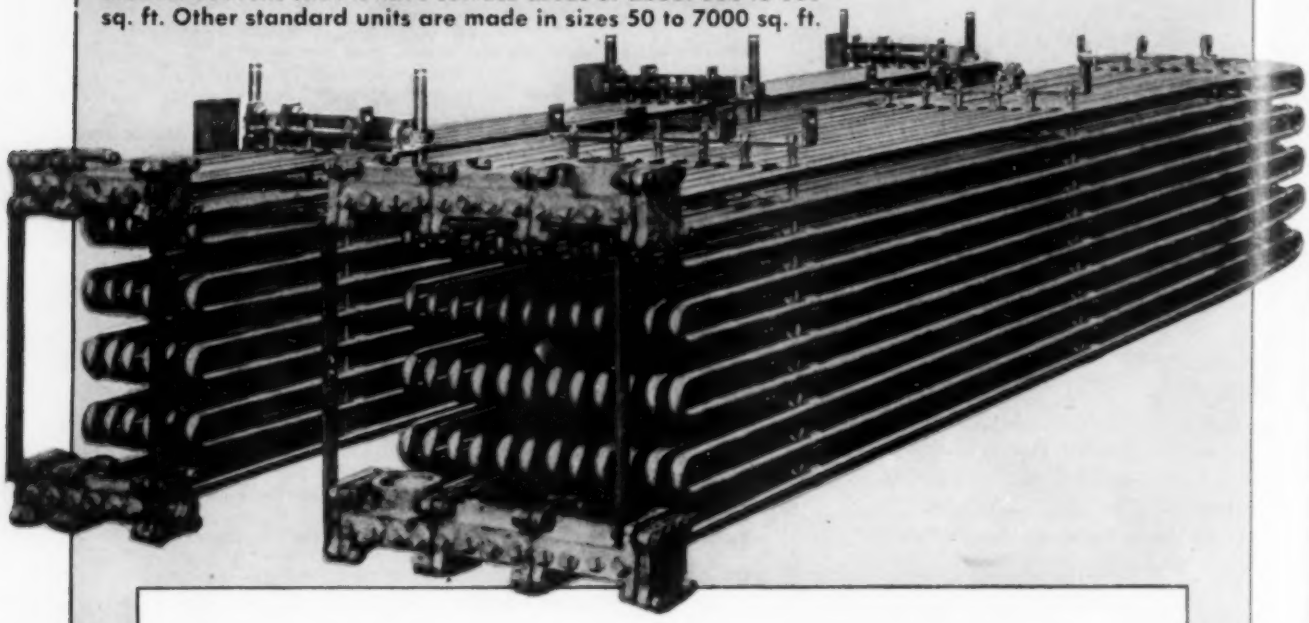
Recovering valuable heat from waste water is the function of these preheaters made by The Whitlock Manufacturing Co., Hartford, Conn. Construction throughout is of copper, brass and bronze. Sections shown have surface areas of about 300 to 600 sq. ft. Other standard units are made in sizes 50 to 7000 sq. ft.



Build with COPPER for Efficiency in Harnessing Waste Heat

PLANTS like laundries and textile dye and finishing mills discharge quantities of hot waste liquids. For them, heat reclaiming equipment built of copper and copper base alloys is a profitable investment. Copper provides long life, maximum thermal efficiency, resists corrosion and prevents contamination of fresh process fluids.

The tubes of these efficient open-type Whitlock Preheaters (waste heat recovery exchangers) are of copper—1¼" O.D. x .058" wall—for high heat transfer rates and a "practically unlimited life in standard installations."

Anaconda Deoxidized Copper Tubes are a favorite among manufacturers of heat transfer equipment, for their consistently uniform quality, high thermal conductivity and excellent corrosion resistance. For many types of heat exchangers and pressure vessels, copper offers economies in fabrication — as well as efficient performance. Call Anaconda for information on copper, in all commercial forms, and the wide range of Anaconda Copper Alloys for heat transfer equipment.

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THE EDITOR'S PAGES

NARC AND UA ADOPT RESOLUTION

In a resolution jointly signed by national officials of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada and the National Association of Refrigeration Contractors, the contractor group recognizes the UA "as the only trade union possessing the sole and exclusive right to perform the work of handling, installing, repairing, and maintaining refrigeration and air conditioning systems of all kinds," and the UA recognizes the local chapters of the NARC as "bargaining agents for agreements effecting wages or working conditions in the refrigeration and air conditioning field in their respective areas."

The NARC and the UA also "agree to unite" in providing a program of apprentice training.

According to Harvey O. Miller, chairman of the labor relations committee of the NARC, the joint resolution should be helpful in clarifying the relationships between the two organizations. "We have now," he said, "an opportunity to take the necessary steps to provide ourselves with adequately trained manpower."

Membership of the NARC, which was formed three years ago, is made up of contracting organizations doing commercial and domestic refrigeration and air conditioning work. It estimates that its member firms employ some 6000 refrigeration mechanics, and that 65 percent of its members' gross comes from sales with 35 percent from repair and maintenance activities. It has 26 local associations in various cities, as well as members at large in other localities. Its headquarters office was recently established at 228 N. LaSalle St., Chicago.

In commenting, at the request of HPAC, on the effect of the resolution on future labor relations and apprentice training in the refrigeration and air conditioning field, Joseph C. Fitts, secretary of the Heating, Piping & Air Conditioning Contractors National Association, stated:

"There is local autonomy in this industry in collective bargaining, recognized as a fundamental principle by the United Association in relation to its local unions and by the HPACCNA in relation to its affiliated local associations.

"For many years, our affiliated local associations have bargained collectively with corresponding units, local unions, of the United Association, in some cases for more than 60 years, and through such bargaining have established the rates of pay, hours, and other pertinent conditions relating to the employment of journeymen pipefitters and their apprentices, who do the piping in connection with air conditioning and refrigeration as well as many other kinds of piping. These collective bargaining agencies have been recognized by both parties for many years and will continue to function in the future as they have in the past."

REPORTS PERFORMANCE OF STEEL WATER PIPE

The tendency of the zinc coating or galvanizing on steel water pipe to dissolve varies with the substances in solution in the water, according to a study being conducted by the committee on steel pipe research of the American Iron and Steel Institute. The first phase of this project, in progress for 1½ years, was reported at the annual convention of the National Association of Corrosion Engineers, at Cincinnati, by R. B. Hoxeng, research associate of Case Institute of Technology, and C. F. Prutton of Carl F. Prutton and Associates, both of Cleveland.

The program was designed to determine the causes of exceptions to the usual long life of galvanized steel pipe in severely corrosive natural waters, and to find means of overcoming this trouble. Ordinarily no pitting of the steel results, because of the electrolytic protection afforded by the zinc. When zinc and steel are in contact in water, the tendency to dissolve the zinc is greater than the tendency to dissolve the steel, so that so long as the zinc remains, the steel is protected. Some exceptional cases have been reported, however, in which galvanized steel was pitted in hot water, changing the normal relationship between the two metals.

In studying these cases it was discovered that bicarbonates and nitrates accelerated the reversal of the normal relationship, while chlorides and sulphates prevented the reversal. For a natural water, therefore, the probability of reversal of the normal behavior would depend on the relative quantities of these chemical substances in the water and to a less extent on the temperature of the water.

BIG PIPE LINE EXPANSION UNDER WAY

"An enormous expansion program of pipe lines is going on in this country with more than 100,000 miles to be added to the existing systems or to new systems in the next three to five years," T. A. Hester, vice president of the Oklahoma Contracting Co., told the construction division of the American Society of Civil Engineers last month. Gas lines totalling 250,000 miles and 119,000 miles of crude oil lines are in operation in this country. The gas lines alone are 17,000 miles longer than the total railroad mileage we have in operation, he said.

AIR CONDITIONING THE NEW CALIFORNIA ZEPHYR

Modern air conditioning equipment is playing a vital role in the passenger comfort picture aboard the transcontinental California Zephyr streamliner, recently put into service between Chicago and San Francisco.

Six complete trains are included in the new $12 million fleet. Each consists of a diesel-electric locomotive, full-length baggage car, three "Vista-Dome" coaches, a buffet-lounge car with "Vista-Dome," a 16 section sleeping car, a 48 passenger diner, three all-room sleeping cars, and a lounge-observation car, also equipped with a "Vista-Dome" compartment. In each "Vista-Dome" compartment, enclosed in a non-glare, heat resistant, safety glass "penthouse," passengers may ride in

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THE EDITOR'S PAGES

air conditioned comfort and enjoy an unobstructed panorama of the countryside.

Each separate car making up the new fleet is equipped with its own individual air conditioning system, the refrigerating units being powered by axle driven electrical generating equipment. Although the load varies in each, a 12 hp compressor-motor unit and a full-flooded type evaporative condenser is standard on all cars.

The compressor-motor unit is mounted under the car in a position convenient for servicing and maintenance. The ball bearing motor has a special pivot type mounting to facilitate belt adjustment or replacement. The unit also has oversized bearings, full pressure lubrication, and heavy duty valves. All motor controls are grouped on a single panel in a convenient locker in the car.

The air conditioning units—which circulate dehumidified, filtered, cool air into all car areas—are connected to overhead distribution ducts. Uniform cooling is assured by multipath distribution heads, which meter an equal amount of refrigerant to parallel passages through the cooling unit. The capacity is increased by a counterflow principle and fast heat transfer is afforded by a staggered tube arrangement.

Modulated cooling is provided by dividing certain cooling units into two sections, each with its own expansion valve and distribution header. When reduced cooling is required, an electrically controlled valve shuts off the flow of refrigerant to the upper section of the unit. At the same time, the compressor speed is reduced to balance the cooling load. Steam coils in the conditioners are operated during winter months, supplying necessary heat to all cars.

Because "Vista-Dome" cars have three separate levels, one of which is the glass enclosed compartment above, the air conditioning load is greater than on cars of conventional design; as a result, equipment with 10 tons of refrigerating capacity is installed on these cars. Air conditioning equipment of the same capacity also serves the dining and kitchen car. The four sleepers, including the 16 section car and three all-room cars, are conditioned by equipment of 7 tons capacity.

One of the most unique cars of the fleet is the "Vista-Dome" buffet-lounge, which provides recreational space for both coach and sleeping car passengers. In the forward end is the buffet-lounge accommodating 19 passengers. Toward the rear is a dormitory section for the crew with 15 berths, toilet facilities, and a shower.

Four tons of air conditioning is directed into the "Vista-Dome" compartment, 3 tons to the lounge, and 3 tons to the crew dormitory, separate ducts leading to the three areas.—L. McCUTCHEON, Frigidaire Div., General Motors Corp.

20 Years Ago

In the lead-off article of Vol. 1, No. 1 of Heating, Piping & Air Conditioning—published just 20 years ago this month—Walter L. Fleisher, writing on the development of air conditioning in industry, pointed out that "Manufacturers noted in the early stages of industry that there were certain days when their goods seemed to work better than at other times. Those days were measured for atmospheric conditions and then duplicated mechanically. It was from these duplications," Mr. Fleisher said, "that modern air conditioning has progressed."

* * * * *

The heading "Heating in 1940" on Samuel R. Lewis' article in our May 1929 issue was a bit of crystal-gazing which has now, of course, become history. Mr. Lewis predicted "better insulation, automatic firing devices, automatic control of heat and cold, and changed types of radiation" as a few of the "1940 heating commonplaces."

* * * * *

The late Albert W. Moulder—contributor of many excellent articles on piping to our pages—introduced his discussion in our very first issue by saying that "Industrial piping is doubtless the most important transportation system of industry." American business should think of piping, he stated, in terms of transportation—"a method of getting anything somewhere at the least possible cost."

* * * * *

Three papers (air conditioning a Detroit office building, overall heat transmission coefficients, and capacity of radiator supply branches), a committee report on heating and ventilating garages, and a bulletin material section appeared in the Journal Section of the American Society of Heating and Ventilating Engineers in HPAC's first issue. Plans for the first of the International Heating and Ventilating Expositions—held in Philadelphia in January 1930—were also reported.

* * * * *

Among the many other articles contributed by outstanding authorities to our first issue was a review of piping for high pressures and temperatures by A. G. Christie. The first illustration showed some of the piping for a pressure of "over 400 lb and a temperature up to 750 deg."

REPORTS SALES AND PROFITS

Sales of the United States Radiator Corp. during its fiscal year ended January 31, 1949, were $21,849,000, it was reported last month by Wesley J. Peoples, president and chairman of the board, in his annual report to stockholders. Net profit amounted to $1,087,000.

Comparative figures for the like period last year were sales of $23,055,000, and net profit of $1,607,000.

Mr. Peoples indicated that a number of problems confronted in the business during the year were now on the way to solution. These included high priced steel and other raw materials in short supply, and restrictions in the use of oil and gas which interfered with demand for that type of heating equipment.

"Having anticipated the readjustment period now widely under way, we face with confidence the return to more normal competitive conditions in business," Mr. Peoples said.

Church Heating Need Not be an Annual Burden

St. Anne's Catholic Church, New Bedford, Mass. Architect: Joseph M. Mosher, Providence, R. I. Equipped with Webster Type "R" Vapor Heating System with prefabricated Webster System Convector Radiation with integral supply valve and thermostatic trap.

Vapor heating is ideal heating for churches — buildings that may require quick heating-up, short "on" periods, long "off" intervals . . . buildings sometimes unoccupied.

For vapor heating at its best, select the Webster Type "R" System. It provides almost instant response to changes in temperature.

In St. Anne's Catholic Church, a Webster Type "R" System provides a high degree of comfort at reasonable cost. There is no overheating. Complete shut-off leaves no residual heat in radiators. Thermostats can be set to maintain desired temperature level.

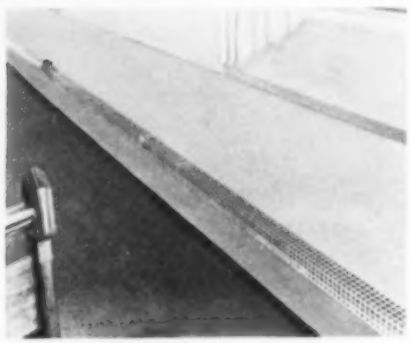
The First Presbyterian Church, consulted Webster for suggestions on modernizing their heating equipment. In 1945 the parish house heating was modernized with a Webster Type "R" System. In 1947 the Church heating was modernized.

Flexibility is demonstrated by the fact that This Webster System can be used with Webster Type "WI" Convectors along the walls or under pews; with prefabricated

Typical arrangement of Webster Type "R" System equipment in basement of First Presbyterian Church, Ossining, N. Y.

First Presbyterian Church, Ossining, N. Y. Built 1898. Heating modernized in 1947 with Webster Type "R" Vapor Heating System. Modernization Heating Contractor: Foster Engineering Company, Mt. Kisco, N. Y.

Webster System Convector Radiators concealed in the wall; with quiet, high capacity Webster-Nesbitt Series "R" Unit Heaters in vestibules; with high, ceiling-mounted down blow units in gymnasiums.



In the First Presbyterian Church, Ossining, N. Y., Webster Type "WI" Extended Surface Radiation installed along both sides close to the floor. Webster System Convectors are used front and back.

Fuel may be coal, gas or oil . . . firing may be manual or automatic. The only limitation is that water return to the boiler by gravity flow.

Vapor heating has its place in modern building — an important place, too. Check on its applicability to your problem.

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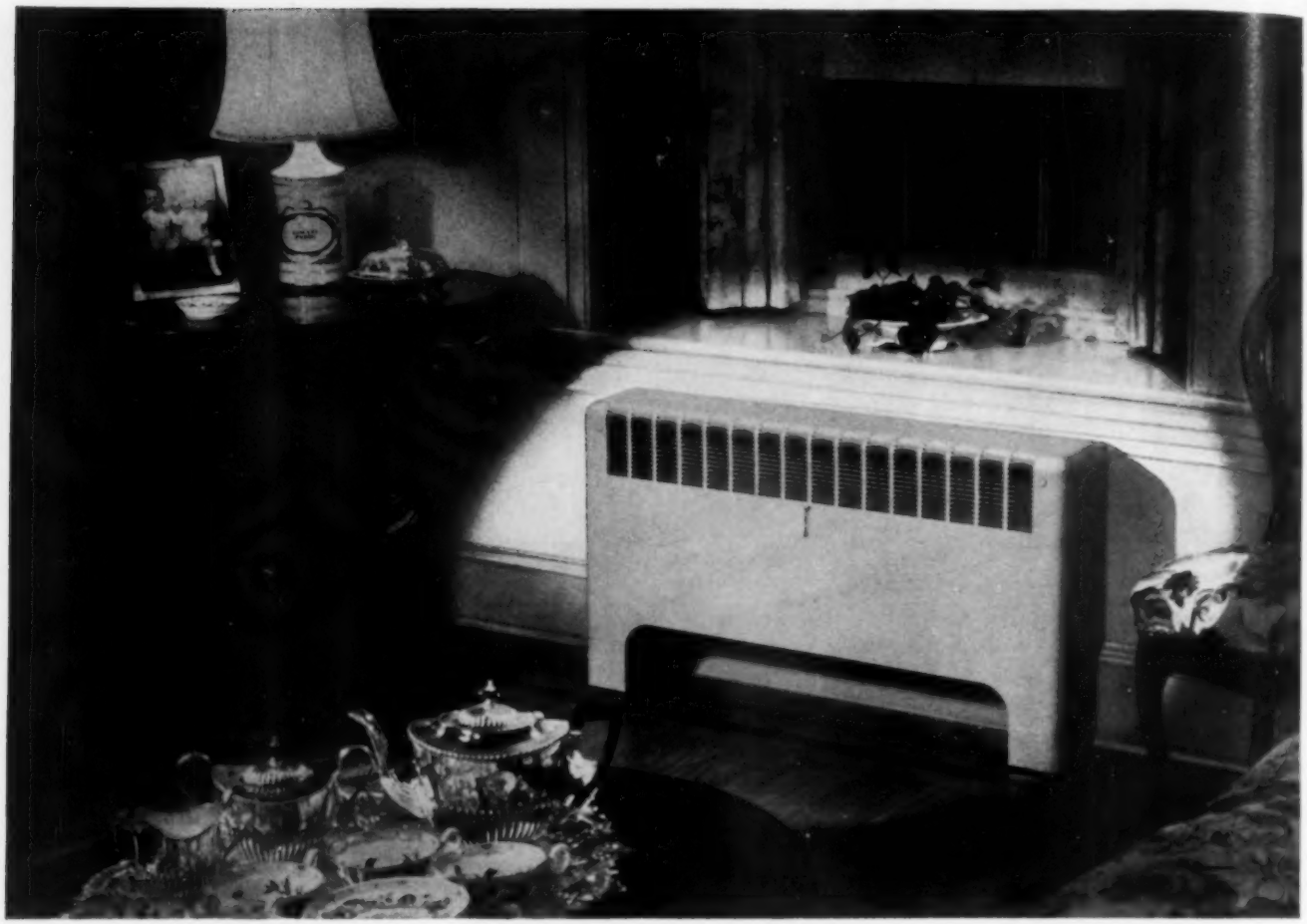
CONVENIENCE AND ECONOMY

These two big points would be reason enough to standardize on Nesbitt Model U Convectors . . . and there are many more good reasons. Nesbitt Convectors are the popular mass-produced, high-quality, low-cost line of twenty standard sizes, stocked for easy selection at your wholesaler's. One-fourth the weight of old fashioned radiators, they are a pleasure to



carry and install. Already assembled and individually packaged, they come forth on your job as clean and fresh as a newly minted coin. Besides giving clean, modern, uniform heat by convection (and radiation), they please customers by the classic design of their metal cabinet and their durable prime gray finish.

Nesbitt Model U Convectors are truly *universal*: They may be installed free-standing or semi-recessed; with two-pipe steam or forced or gravity hot water systems. The Nesbitt fin-and-tube heating element requires only two simple connections which may be made without removing the element from the casing. Time is money, these days!

The curve-top grille is exclusive with Nesbitt. It gives more flue action, greater heating capacity. Dampers are available when desired. We could go on and on! Why not try Nesbitt Convectors on your next job?

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"OPEN for DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address them to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2

EXCELLENT DATA ON INDUSTRIAL VENTILATION

I HAVE read the April article on industrial ventilation by Robert C. Soronen, describing his successful treatment of a fog problem in a veneer mill, with great interest. Aside from the features of the system, which show excellent analysis and application on the part of Mr. Soronen, I was particularly interested in this article as a striking example of the fact that even the "toughie" problems in removing contaminating agents from industrial atmospheres are subject to treatment by simple quantitative means.

By comparison, the earlier approaches to this particular problem were apparently characterized by either inadequate rule-of-thumb methods, or by faulty application of the general principle of diluting contaminating agents in the atmosphere to a tolerable level. It has long been my belief that if designing engineers would apply to industrial ventilation problems the same analysis, insight, and careful calculation which they bring to problems in other fields such as air conditioning, that there would be fewer of those cases of improper design and application which continue to relegate the ventilation science to the role of an art.

Incidentally, the data given in Mr. Soronen's article, on which the design of his system was based, are in excellent agreement with data which I understand are soon to be published by the American Standards Association for large open tank exhaust systems. — H. A. MOSHER, Eastman Kodak Co., Rochester, N. Y.

"QUOTE"

"The whiplash of national and global planners, self-anointed, self-appointed and self-applauded, will surely not conjure up the high level of accomplishment involved in the intricate workings of millions of individuals striving for personal improvement and advantage. It is the strife and competition of every individual every day that produces the really collective good—and the collective security—which the planners with their simpering semantics, cold logic, and slide rules would have you think is their province."—ROBERT E. MARSHALL, assistant secretary, Worthington Pump and Machinery Corp., in a recent address.

VENTILATION ENGINEERS SHOULD PUBLISH RESULTS

I HAVE reviewed the article by Robert C. Soronen on industrial ventilation, published in the April HPAC. I want first to compliment Mr. Soronen for taking the time to describe his work in print. I have insisted for some years that industrial ventilating engineers do not spend the proper amount of time to prepare concise reports for printing in technical and trade journals. Much of the best information on practical solutions to difficult problems is buried in the files of ventilating engineers, with excellent prospects of being destroyed before anyone can bring the information to light.

I am intrigued by Mr. Soronen's reference to a rate of 200 to 250 cfm per sq ft of vat surface for the control of steam or fog. This agrees with my own observations on the required rate for open tanks containing water or water solutions near the boiling point.

I commend his control of air movement from the veneer room through the bark removal room and into the vat loading room. This progressive passage of air from room to room is useful in many situations as an air or heat conservation measure.

Mr. Soronen indicates in the last paragraph of his article that he intends to describe other installations in a future article. His approach to the veneer mill problem seems eminently practical to me, and I would certainly encourage him to continue his writing. — W. N. WITHERIDGE, ventilation consultant, General Motors Corp., Detroit.

WHAT'S HEAT OUTPUT OF RADIANT JOBS?

IN THE APRIL issue of HPAC, D. L. Mills commented on my article, Floor Surface Temperature and Heat Output With Radiant Jobs, which appeared in the March issue. A month-to-month discussion of the subject could be carried on indefinitely, but I would like to answer Mr. Mills' comment because I believe he has misinterpreted the purpose of my article. He asks, "Why not verify claims with actual data developed by proper instrumentation from actual operating conditions?" The only "claims" I make are that practice and theory do not agree or, in other words, that radiant heating systems are producing comfort with heating loads calculated by standard procedures to be one to three times as great as the purely theoretical limit. This situation exists in thousands of cases and I do not believe any further verification, by instrumentation or otherwise, is necessary.

In attempting to determine why such a wide difference exists between practice and theory, I did suggest a number of possibilities. Such an analysis of a problem does not constitute a "claim." In fact, in my conclusion I made the following statements, which seem to be in agreement with Mr. Mills' suggestion of a field investigation of radiant heating:

"The primary purpose of this discussion is to present such an analysis of the problem and, while a complete solution is not to be expected from a simple study of this kind, it is hoped that it will explain why differences of opinion exist and perhaps result in some adequate and immediate field or laboratory research by some competent, unbiased organization. The ASHVE research program should success-

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"OPEN for DISCUSSION"

fully solve this problem, but the long-term character of this radiant heating investigation may not permit the release of useful data for several years."

Mr. Mills further comments that "The fact that a particular installation was calculated to produce 60 to 100 Btu per sq ft of floor area, and comfort conditions have apparently been obtained, is no reason to believe that the actual output from the panel is as high as the calculated value." This statement is a little embarrassing to me because I attempted in my article to bring out this very point. Such factors as lower air temperature in a radiant heated room, less air movement, lack of stratification, use of too low minimum design temperatures, conservative design factors, individual designer's safety factor, and others all contribute to the difference between actual and calculated. Ordinarily, we would gladly accept them as a margin of safety, but when the margin reaches as high as 200 percent, I think it is time to admit that the currently accepted theoretical analysis of radiant heating might need some revision. Mr. Mills mentions the possible difference between "actual" and "calculated," but he does not comment on the suggested variance between "actual" and "theoretical." I believe we should carefully scrutinize both.

And to Mr. Mills and others who may not have carried out any field investigations with instrument accuracy, I should like to give a word of advice. It is a tremendous task which, to be done correctly (at minimum design conditions, for example) in all types of buildings having all types of structural and functional characteristics, would involve an expenditure of hundreds of thousands of dollars and a staff of competent men—a task which I do not believe any one manufacturer in the heating industry today is equipped to undertake. It is for this reason that we are all awaiting the results of the current ASHVE radiant heating research program. —PAUL S. PARK, manager, engineering service dept., A. M. Byers Co.

STRETCHING DEHUMIDIFIER PERFORMANCE

I WAS VERY interested in the comments that John Everetts, Jr., and H. W. Heisterkamp made on my article on dehumidifier performance, which comments were published in April. However, I should like to defend my article against some of the points which Mr. Heisterkamp makes.

In my opinion his counter-examples do not hit the point of the article. I do not claim to increase the moisture removal capacity of the unit—a glance at the performance curve on page 682 of the 1948 Guide shows the lowered efficiency at lower grain levels—but rather to obtain a dryer effluent air than is possible in the customary hookup.

In his first counter-example, Mr. Heisterkamp has to use twice the amount of air, with the concomitant increase in duct work which is mentioned in my article.

His second proposal uses two 400 cfm dryers in place of my one 800 cfm unit. This is, of course, a much more expensive method—not to mention the additional mechanical equipment involved.

For these reasons, I believe that the term "stretching" is quite justified, for the run-around system described in my article permits the dehumidifier to deliver dryer effluent air than any other standard hookup.

As regards the 5 percent leakage allowance mentioned by Mr. Heisterkamp, it seems to me that this should really be incorporated in the performance data of the unit. —PETER FRANCK, Armo Cooling & Ventilating Co., New York.

NEW TECHNIQUE FOR WELDING CHROME PIPE DISCLOSED

DEVELOPMENT of a new procedure for welding 4-6 chrome pipe was disclosed recently by Houston Pipe and Steel, Inc., of Houston, Texas. The new process was devised by the company for use in the welding of chrome pipe being fabricated for installation in a large Texas oil refinery.

M. Van Blaricom, chief engineer of Houston Pipe and Steel, Inc., explained that in the new process a large preheating tip with oxyacetylene was used first to bring the temperature of the joint up to 600-800 deg and keep it there while the welding was done using a chrome electrode (ASTM AWS Spec. No. E-502). After this, he said, the temperature was raised to 1200-1350 deg and the joint was wrapped with asbestos tape to a minimum thickness of 1 in. and cooled to room temperature.

Mr. Van Blaricom pointed out that—contrary to popular belief—this technique did not make the weld metal so hard that it became brittle. Laboratory tests certified by the Shilstone Testing Laboratory, Houston, he stated, showed very desirable results. The figures he presented showed an ultimate tensile strength of 73,200 psi, and a satisfactory rating on a 180 deg root bend. Brinell hardness in the weld was indicated as 248, while Brinell hardness in the pipe was 174. A Charpy impact notched test was made in the weld metal at 70 deg, 49.0 ft-lb. Chemical analysis of the weld metal showed 7.73 percent Cr in the weld and 4.53 percent Cr in the pipe. According to Mr. Van Blaricom, where greater ductility and elongation was required, a furnace anneal at 1600 deg was given after the pipe had cooled. This resulted in an average elongation of 40 percent in 2 in.

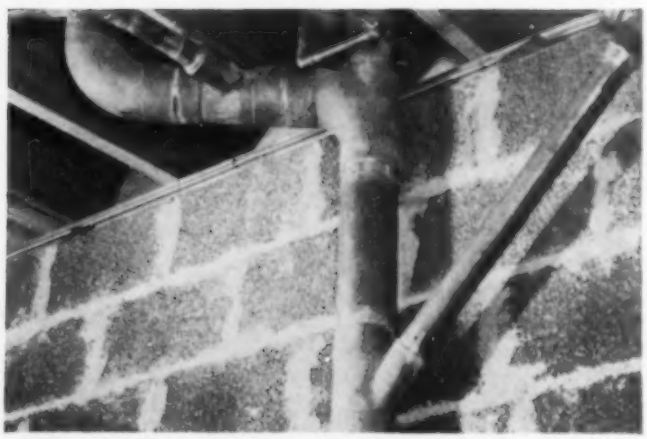
"The excellent test results proved without a doubt the practicability of our new procedure," he declared. "We used it throughout the production of the chrome pipe and the lot was completed satisfactorily, quickly, and inexpensively."

NEW YORK ADOPTS SMOKE CONTROL LAW

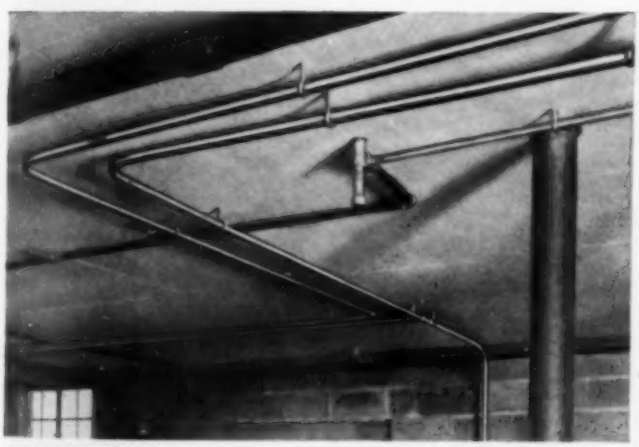
Declaring that "pollution of the atmosphere by smoke, soot, fly ash, products of combustion, incomplete combustion or heating of fuels or refuse and certain other emissions into the atmosphere" to be "a menace to the welfare and comfort of the people of the city and a cause of extensive damage to property" a local law amending the administrative code of the city of New York establishing a smoke control board became effective March 1.

TROUBLE always costs more than
REVERE COPPER WATER TUBE

HEATING. When you install radiant panel, or forced circulation hot water heating systems, you save time and trouble with Revere Copper Water Tube. You can bend this tube readily, and joints are quickly made with either soldered or compression fittings.



SOIL, WASTE AND VENT LINES. Revere Copper Water Tube is used for drainage because it is so highly resistant to corrosion attack. The interior remains smooth, permitting unobstructed flow and eliminating the tendency of lines to clog.



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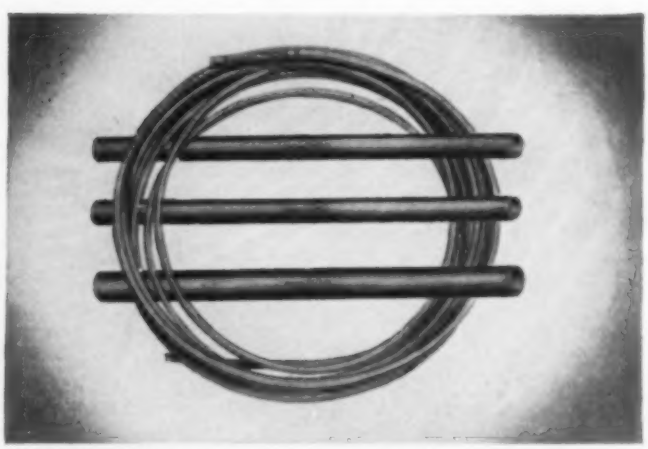

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* * *

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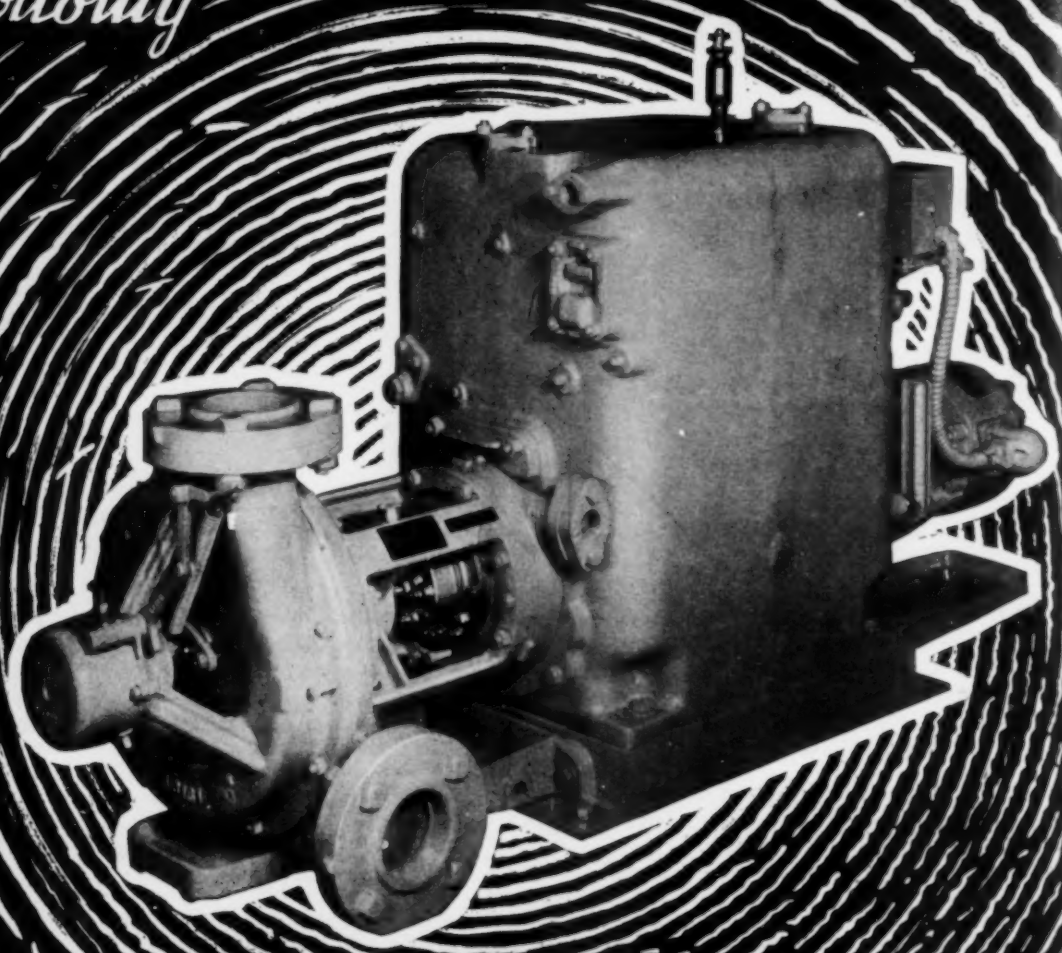

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THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Piping, Heating and Ventilating North Western's New Diesel Shop

H. P. WATSON, of De Leuw, Cather & Co., engineers, describes the piping, heating, and ventilating of the C. & N. W.'s new shop for the service and repair of diesel locomotives. Diesel equipment has introduced a problem of service and maintenance which is of an entirely different nature from the servicing of steam equipment, and this shop has been designed to meet this problem. How the piping, heating, and ventilating installations aid efficient service and repair is clearly explained in this very timely article

WHEN THE FIRST diesel locomotive was put in service on an American railroad in 1925 and its value demonstrated, a trend was started which continues to such an extent that today even coal carrying roads are adopting diesel power. The western roads have carried the trend to such a point that now practically all of their fast service and much of their secondary hauling is handled by diesels.

The Chicago & North Western railway has been among those in the vanguard of the diesel trend. All of its crack "400" passenger trains serving the area from Chicago to points in Minnesota and Wisconsin are now drawn by diesels. Likewise, all of the streamlined "City" trains operated in conjunction with the Union Pacific between Chicago and the west coast have diesel motive power. Approximately 15 percent of its road freight motive power has been dieselized, and the trend has continued to switch engines, particularly at the larger terminals.

Why Diesel Shops Are Necessary

The adoption of this equipment introduced a problem of service and maintenance which the roads soon found was of an entirely different nature from the servicing of steam equipment. The first attempts at overhaul or heavy repair of diesels were made in converted stalls in existing roundhouses. This arrangement soon proved entirely unsatisfactory as units became too long for either existing roundhouse stalls or for turntables. In many cases, attempts were made (some reasonably successful) to convert old car-shop buildings. Usually this meant using a building that was located or arranged poorly for fast servicing. This work is best done on a through track. As the old buildings did not lend themselves to a through track arrangement or to the installation of wheel drops, many of the roads soon found themselves doing such servicing outdoors.

The heavy repairs fared a little better in the old buildings, as the stub track arrangement in such buildings lent itself better to the slower work of major overhaul. Here again there were difficulties, however, as the heavy overhaul shops require a cluster of smaller shops around them. No heavy overhaul shop can operate without space for filter and parts cleaning, engine overhaul, electrical work, a separate room for injector and governor work, a machine shop, a battery room, and large stockrooms for parts, oil and grease. Where such shops could be arranged close to the heavy overhaul bays, the old buildings have worked out to fair satisfaction, provided that suitable comfort and health facilities could be installed for the employees.

The majority of roads did not have such readily adaptable facilities, and those that did have the facilities and who made such adaptions soon found that their arrangements and contents incorporated a lot of "steam engine thinking." Hence, it became obvious that a new line of thought would have to be incorporated into the design of

About half the heat loss of the service and heavy repair wing is handled by a panel heating system, with unit heaters carrying the remainder of the load. This construction view shows the piping for the radiant heating being installed

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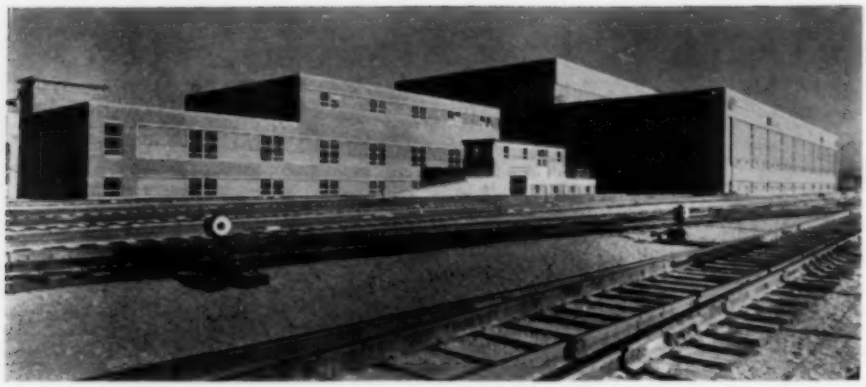

General elevation of the diesel shop, looking northeast. Outdoor air intakes may be seen on the wall at the right

service and repair shops for diesel locomotives.

Over the past 10 years, many shops have been designed and built for the service and repair of diesel locomotives. Each design has represented an attempt to improve on the previous ones. The latest in this series is the Chicago shop for the North Western system. Located in the 40th Ave. yard in the heart of the city's west side, it is used for the servicing of passenger road engines and switch engines, and the heavy repair of all types of diesel motive power. A second shop is now under construction for the servicing of freight engines at Proviso.

Building Consists of Two Major Wings

The Chicago shop building consists of two major wings, one housing the service and heavy repair departments, and the other the small shops and storerooms.

The service and heavy repair section is made up of a high bay portion and a low bay portion. The high bay section is 250 ft long by 80 ft wide by 40 ft below the trusses. This section houses one through track for service, one stub track for heavy repair, and a truck release track. The low bay portion adjacent to and not separated by a partition from the high bay section houses two through tracks for service. The low bay section is 250 ft long by 60 ft wide by 26 ft, 4 in.

An overhead bridge crane spanning the width of the high bay section serves the tracks in the bay. A wheel drop pit 23 ft, 6 in. wide by 135 ft 6 in. long by 18 ft deep runs the entire width of the building near the east end. Along the north side of the building, two truck storage tunnels connect with the drop pit.

The shops and stores wing is a two story and basement structure which abuts the service and heavy repair wing on the west beyond the heavy repair and wheel tracks. The second floor of this wing houses the toilets, lunch, locker and washrooms. The first floor houses the parts conditioning room, the injector and governor room, the filter and parts cleaning room, and storage space. The basement houses storage space and a utility room for the building mechanical equipment. A pipe tunnel leading off of this room crosses the entire width of the service and heavy repair wing at the west end.

The service tracks within the building are provided with permanent concrete platforms at an elevation of 5 ft above the rails on each side of the three tracks. The first floor in the service section is 2 ft, 6 in. below the top of rail, with a 4 ft, 6 in. center depression between the rails.

The building is a steel structure with brick curtain walls, and with reinforced concrete slab floors and platforms. The roof is of precast concrete slab. Doors at all track entrances are overhead rolling steel doors with power operators. Glass block was used liberally to provide as much daylight as possible.

An interesting sidelight on the building design is that it is probably the first heavy construction in Chicago designed entirely for modular materials.

At the east approach to the building between the tracks are located the outside service platforms. These consist of paved concrete areas approximately 200 ft long parallel to the tracks. Such functions as fueling and sanding of locomotives are accomplished at this location.

A discussion of the apparatus, tools, and equipment used in the repair of the locomotives would fill another article the length of this one or longer, but aside from such equipment, the mechanical installations in and adjacent to this building consist of the following: (1) A heating and ventilating system, (2) a sanitary plumbing system, (3) a service water and drainage system, (4) a pumping and dispensing system for new lubricating oil, (5) a disposal system for used lubricating oil, (6) a pumping and dispensing system for fuel oil, (7) a sanding system, (8) a compressed air system, and (9) fire protection.

Unit Heaters for Shops and Stores Wing

The heating and ventilating of the shops and stores wing presented no particular problem. Unit heaters are used for heating throughout the first and second floors. Exhaust ventilation is used in the toilet room, the lunchroom, and in the filter and parts cleaning room. No effort was made to introduce fresh heated air in the toilet and lunch rooms as no great amount of air is being exhausted. Fans adjacent to the cleaning tanks in the filter and parts cleaning room exhaust 9200 cfm of air; this is made up by infiltration from adjacent rooms, one of which is the governor and injector room. This latter room requires relatively dustfree air, so fresh filtered air is introduced to this room by ordinary school room type unit ventilators. All of the rooms in this wing have ample window area to provide summer ventilation.

Ventilation for Service and Heavy Repair

The heating and ventilating of the service and heavy repair wing present more of a problem—although a familiar one. It is the problem of a large open space in which conditions of comfort must be maintained while a considerable volume of air is being moved, both from mechanical ventilation and from infiltration due to the opening of the large doors for ingress and egress of the locomotives. The problem is made more severe by the fact that each entering locomotive represents several tons of "refrigerated steel" which immediately begins to absorb heat.

If no engines were to be run in the shop, ventilation would be no problem as the volume of the structure is so large in proportion to the number of occupants that infiltration would more than care for their needs with the addition of a few gravity roof ventilators to provide summer air circulation. Engines will be run in the structure, however, while servicing and testing is taking place. The fumes from diesel exhaust are low in carbon monoxide and are not particularly toxic. However, the fumes contain a considerable percentage of SO_2, and frequently some unburned carbon in the form of smoke. The smoke is disagreeable and dirty, and the SO_2 causes irritation to the eyes and nasal passages. These must be moved by mechanical ventilation.

An obviously simple means of disposing of these fumes would be to trap them as they leave the exhaust ports on the engines. Every designer of mechanical equipment for diesel shops probably has had this idea at some stage of his experience; however, he soon finds that any such arrangement is complicated by the fact that diesel engines have a multiplicity of exhaust ports, and that there is no standardization of the locations of these ports. In most shops the problem is further complicated by the presence of a bridge crane or monorail over the tracks.

Hoods with Ventilators Handle Exhaust Fumes

At the North Western shop, it was decided to build hoods over sections of each of the service tracks. These hoods are nothing more than vertical baffles dividing the area over the service tracks into compartments. The baffles are brought down as close to the tops of the engines as clearances will permit, in this case 20 ft 10 in. above the top of rail. (Engines average about 15 ft above top of rail.) A power roof ventilator of 10,000 cfm capacity is installed near the midpoint of each compartment, and each compartment is approximately 20 ft by 25 ft.

As fumes from an engine leave the exhaust port at high temperature, they immediately rise and, unless removed, will slowly cool and stratify and eventually settle to the floor. It is intended that the fans will be operated over those sections in which an engine is running, and will carry off the fumes before they have had time to cool. Only an operating test over a number of different conditions will prove if the system is ample. Eight of these roof blowers are installed, but as only a few of them will be operated at any one time, the movement of air will not be so excessive as to make the heating of replacement air prohibitively costly. This is just what would have happened had a system of general ventilation been installed with, say, six or more air changes.

As it is, a total of 51,000 cfm of heated fresh air is being supplied to the service bays. All engine running—except for entering and leaving—takes place in the low bays.

Gravity ventilators with motorized dampers are installed over the high (heavy repair) bays.

Mechanical supply and exhaust air is also provided for several small shops having no outside exposure, and to the drop pit. These small shops have not heretofore been mentioned and are located near the center of the building between the service and the heavy repair sections.

All of the fresh air is supplied through blower type units suspended in the trusses and taking air from above the roof or through the outside wall near the roof. Air is distributed through a system of ducts connected to these units. The units normally take 100 percent fresh, filtered outside air. Control is by face and bypass dampers modulated by a duct thermostat in the air discharge. Another motor closes an intake damper if the fan motor is not running. The motor cannot be started if no steam is on the coils. Control is set at slightly in excess of room temperature.

Panel Heating and Units for Heavy Repair Wing

The heating of the service and heavy repair wing is a separate (though related) problem from the ventilating. Buildings of this type, with high ceilings but where most of the occupants are working at or near the floor, have seldom been heated with any degree of comfort, particularly when there is frequent door opening, allowing large sweeps of frigid air to enter, and where cold equipment is brought in having a large negative radiant effect. Despite its initial cost, a radiant floor panel job seems the obvious answer.

If all of the heat losses (exclusive of ventilation air, already discussed) were to be made up by radiant coils in the floor of a building having such a huge mass of concrete in that floor, then with even moderately sudden rises in outside temperature, the heat lag in such a mass would cause uncomfortable overheating. It was therefore decided to make up approximately half of the heat loss by the panel heating and the balance with unit heaters. The panels provide a feeling of warmth to the men working around and under the engines. The unit heaters provide flexibility to accommodate sudden changes in the weather, and help quick recovery of air temperatures after the

An interior view of the service and heavy repair section, with the air supply units in the low bay section

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doors have been opened. The inherent lag in the floor mass contributes even more strongly to the return to comfort conditions after the doors have been open.

All unit heaters are on 10 psi steam, except those taking outside air which are on 100 psi steam.

This sanding truck simplifies servicing of diesel locomotives

Steam is supplied to the building at 160 psi from an existing power house at the yard. The radiant heating system is on hot water, which is generated by a heat exchanger with water temperature at the outlet regulated to 140 F. Water temperature to the zones is regulated by three-way mixing valves, each of which is in turn controlled by an inside thermostat and an outside limiting thermostat.

Piping for the most part is 1¼ in. wrought iron on 12 in. centers, with the top of the pipe 2½ in. below the surface of the concrete. It is anticipated that under design conditions water will go out at 120 deg and return at 100 deg. Floor temperatures at design conditions should be 85 deg and heat emission per square foot of floor area is anticipated as 69 Btu.

The figures in the preceding paragraph are open to controversy and it is not the intent here to go into detail concerning them. In fact, were this job being redesigned today, it would be calculated by a different method but probably with much the same result. Suffice it to say that during its brief span of operation, the system has gone through one test at minus 5 F, and several other days near that temperature—and the heating system has come off with flying colors.

Snow Melting Coils for Outdoor Platforms

Before concluding these remarks about heating, the systems for snow melting should be mentioned. Snow melting coils are placed below the concrete slabs of the outdoor service platforms at the east end of the building, and under two ramps leading into the building at the west end.

Because of the nature of the layout, the pipe had to be installed in long loops. To minimize friction head loss, 2 in. pipe is used on 18 in. centers. Water will be supplied at 160 F, with an anticipated drop of 40 deg. An output of 145 Btu per linear foot of pipe is estimated, of which 116 Btu represents useful heat (the balance being lost to the earth). These figures represent a condition of stabilization. It is highly uncertain how much lag will be involved in the functioning of such a system, but the heat exchanger is oversized 20 percent to provide pickup. Calculations were based on sufficient heat to melt a 1.5 in. snow in 1 hr, assuming snow at 0.49 lb per sq ft per in. of depth.

The coils are in gravel immediately under and partially embedded in the 6 in. slab. The system at the time of this writing has not had a real test.

Piping Service Outlets for the Platforms

Service outlets for water, high pressure steam, and compressed air, and power receptacles, are located throughout the building. The lines for the service platforms are run snug against the undersides of the platforms with valved service connections for hose at 50 ft intervals along the length of the platform. The power receptacles are likewise on 50 ft centers at the midpoints between the hose outlets. All of these connections serving the platform above are located in circular iron boxes in the floor. Each service has a separate 8 in. ID box with cover. All of the piped services are ¾ in. The water and air have hose connections of the quick coupling type; the steam has a union connection. The outlets in the platforms are located near the edges so that hose will not have to be laid across the platforms to reach the engines.

To serve the area below the platforms, these services are brought down at every column, with steam, air, and water on one side of the column and power on the other. The columns, incidentally, are located at the centers of the platforms, with the platforms cantilevered out from them so that column locations cause a minimum of interference with working space.

Railroad Oil Barrel Becoming Obsolete

In modern diesel shop practice, the traditional railroad oil barrel is becoming completely obsolete except for a few special greases which are used in small quantities. In modern shops, crankcase oil is stored in large tanks and is pumped through a piping system to the points of usage. At the North Western shop, the oil is stored in a 14,000 gal tank in a separate oil house some 500 ft from the shop. The oil house is a remodeled existing building. The tank is rectangular to economize on space in the house. It is equipped with a steam suction heater to heat the oil as it leaves the tank to enter the suction pipe to the pump.

The oil used is a special grade, in characteristics about midway between SAE 40 and 50. Viscosity at 120 F is approximately 500 SSU. As temperature drops, the viscosity increases rapidly and at 100 F it is near 1000 SSU, and at 70 F it is near 1500 SSU. In order to maintain the oil temperature at or near 120 F, a system of steam tracer piping is used with the oil piping. Steam at 10 psi is used, and control (except at the tank) is manual. Indicating thermometers are installed at convenient locations so that oil temperature may be watched.

Rotary pumps are used to pump against a hydraulic-pneumatic tank, the pump being controlled from a pressure switch on the pressure tank. Hence, oil under pressure is always available in the piping. Oil is drawn from the system only intermittently, and as the oil in the tank system is always kept warm, it is necessary for the user of the oil to watch only the regulation of the temperature of the oil as it is

affected by the steam tracer piping.

Oil is dispensed in the diesel shop at six stations. Three of these are on the service platform between the first and second tracks, and the other three are along the platform between the third and fourth tracks. Each of these stations consists of a 1½ in. line strainer; a 1½ in. meter of the measured discharge, ticket printing type; a plug cock; a manual rewind side cabinet hose reel with 50 ft of 1¼ in. hose; and a filler nozzle.

It was assumed that not more than two hoses would be in use at one time, so with flows of 25 gpm at each hose, a pump of 50 gpm, 60 psi capacity was selected (actually a 90 gpm pump geared down to 50 gpm with a 5 hp motor). Two pumps are installed, each a standby to the other. A 4 in. main line runs from the oil house to the diesel shop and a 2 in. branch is taken off it to serve each group of three dispensers. The 4 in. main is run underground with a 1¼ in. tracer in a wood box conduit.

A separate 90 gpm pump is installed for unloading lube oil from tank cars. In some installations the standby dispensing pump is manifolded so that it can be used for car unloading, but because of the nearly constant usage of crankcase oil anticipated at this shop, it was believed more desirable to have full standby for the dispensing pump.

Disposal of Used Crankcase Oil

For disposing of used crankcase oil, a system of pipes was laid under the floor in the service area. Branches from these pipes stub up into floor boxes at 50 ft intervals along each of the four main tracks within the shop. In each box is a 1½ in. lever handle plug cock and a hose connection. Crankcase oil is drained by gravity through this system to a concrete sump at the west end of the shop. Should the oil be too stiff to flow freely, it is helped along by live steam introduced into the crankcase or piping. All piping is class 150 cast iron with screwed drainage fittings. Mains are all 4 in. Plug cleanouts flush with the floor are provided at frequent intervals.

Fuel Oil Dispensing Piping Systems

The fuel oil dispensing system is supplied from a tank of 150,000 gal capacity located near the oil house, with the pumps in the oil house. In this case, because less trouble is anticipated from fuel oil than from lube oil pumping, the pumps are manifolded and two pumps handle all unloading and dispensing.

Each pump is the rotary type with a bypass in the head and each has a capacity of 200 gpm, with a 10 hp motor. To conserve space, the pumps are installed one above the other. The pumps are started by pushbutton stations located at the dispensers and at the pump house. An air release is installed in the line leading to the dispensing stands which are located at the outdoor service platforms at the east end of the diesel shop. There are three dispensing stands on each of three tracks, with a ticket printing type meter in the line serving each of the three tracks.

Dispensing stations consist merely of 2½ in. stubs brought up above the ground between the rail and the concrete paving, terminating in a 2½ in. angle valve to which is attached a swing joint and 20 ft of 2½ in. synthetic hose and a nozzle with a quick coupler for attaching the hose to the tank connection on the engine.

All main piping is run underground and it is all 3 in. During its entire length of run the underground pipe is either under tracks or closely parallel to tracks, so a conduit of 6 in. extra heavy cast iron soil pipe is provided for protection.

Simple, Flexible Sanding System

The furnishing of dry sand for steam locomotives has for many years been accomplished by pneumatically conveying the sand from the sand drying house to the point of usage, using compressed air from the terminal compressed air system. Elevated sand storage tanks are installed at the points of usage into which the sand from the conveying pipes is discharged. From the tanks (universally known as sand towers) the sand flows by gravity to the locomotive sand boxes. Because each sand tower must serve two or more tracks, and sand boxes are at various heights on the engines, they are frequently quite lofty.

These towers have required rather accurate spotting of the engines to be within range of the sand spouts. With steam locomotives, this is not too difficult as the engines have to be spotted only once. But with diesels, some of the three unit jobs totaling 200 ft or more in length, the sanding requires several spottings or multiple sanding systems.

To provide a simple, flexible sanding system for the North Western diesel shop, a standard high lift truck was fitted with a 40 cu ft, vertical, cone bottom tank. In lowered position, the truck is run under a sand tower for filling, and is elevated to allow sand to flow to engine sand boxes by gravity. An engine can be sanded at any position along the outside service platform. One sand tower is used, which incidentally has a spout on one side for sanding switchers.

Sand is conveyed to the tower in the conventional manner using cast iron flanged pipe with special wearing elbows. Pipe is run overhead,

Snow melting coils being installed at east end of the building. The structure in the middle foreground is the sand tower

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and as spans between uprights are long, steel trusses of sufficient strength to carry several future pipes are used.

The compressed air system is a conventional one. Piping connections were made to an existing compressed air header in the remote power plant, and brought overhead through several buildings to a new air receiver at the new building and thence through distribution piping throughout the building. Lubricated cock valves are used in all air piping. Drainage is conventional.

Fog Throwers for Fire Protection

The subject of fire protection involved considerable discussion. The most likely fires in a diesel shop would be from a petroleum product or of an electrical nature. Since the building is in service 24 hr a day, it was thought that a system of hose cabinets with fog nozzles would be most effective. Small 1 in. fog throwers are located at frequent intervals throughout the building, with larger 1½ in. hose cabinets at less frequent intervals. The 1½ in. lines are provided with adjustable nozzles to throw a fog or a stream. A fire pump boosts water from the city mains to 100 psi. The pump will start when any nozzle is opened.

All pipe for the steam, condensate, lube oil, fuel oil, and compressed air is black steel welded. Pipe for service water and fire protection is galvanized steel with screwed or flanged connections. Other services are piped as hereinbefore mentioned.

Tight Spot for Piping in Basement

A tight spot was encountered in running pipe through the basement of the shops and stores section where 8 ft of headroom had to be maintained with only 9 ft below the beams. Needless to say, all piping had to be run without pitch except the condensate return. The return is carried around the outside walls. The pipe along one wall could then be run directly back to the utility room, but the other side had to be taken to a small condensate pump which lifts the condensate to the main receiver in the utility room.

All work in connection with this project was under the general supervision of E. C. Vandenburgh, chief engineer of the North Western, and under the direct supervision of B. R. Meyers, assistant chief engineer. Mechanical work was done in close cooperation with the road's mechanical department, headed by G. W. Bohannon. Plans and specifications were prepared by De Leuw, Cather & Co., engineers, Chicago. The general contractor was S. N. Nielsen Co., Inc. The piping, heating, and ventilating contractor was M. J. Corboy Co., with the Narowetz Heating and Ventilating Co. as the ventilation subcontractor.

AIR CONDITIONED PLANE HAS ALUMINUM COMPRESSORS

THE FIRST completely air conditioned passenger plane using equipment similar to that in sizable buildings, has been delivered by Boeing Airplane Co. to Pan American World Airways. The ship, a giant, double-deck, pressurized Stratocruiser capable of carrying up to 114 passengers, is a peacetime development of the famous B-29. It has a cruising range of 4600 miles at a cruising speed of 300 to 340 mph.

The air conditioning system is entirely new in aviation history, according to Carrier Corp. Designed by Boeing air conditioning engineers, it maintains passenger comfort automatically, regardless of whether the outside temperature is 100 deg, as on a landing field, or 65 deg below zero in the stratosphere. It also controls humidity, air flow, and air cleanliness.

Heart of the system is two aluminum compressors which operate a "Freon" gas refrigerating system. They produce a cooling effect equivalent to the melting of 10 tons of ice in 24 hr. Built especially for air transportation, they weigh only half as much as compressors of similar capacity made of the customary iron and steel construction.

Heretofore, passenger planes have had only limited air conditioning through distribution of outside air drawn in and circulated by the plane's engines. Such systems are inadvisable at altitudes where subzero temperatures prevail, and do not work while the plane is on the ground, unless an engine is kept running. The new Stratocruiser system operates while the plane is stationary by merely plugging into an electric outlet.

The pre-cooled or pre-warmed air is circulated throughout the two decks of the plane through hundreds of feet of plastic ducts. Air flows into the cabin at the rate of 3600 cfm and is completely changed every 90 sec. Filters remove dust, dirt, and tobacco smoke color; activated charcoal removes odors.

The filters removing smoke color also remove a large percentage of airborne bacteria, making cabin air purer than in the average home.

Seventy five percent of the cabin air is cleaned and recirculated, while 25 percent is outside air, delivered by the engines' turbosuperchargers.

Window panes are double, with the cabin air passing between them, thus removing the frost and fog caused by the differences between inside and outside temperatures. Routed between the lining and soundproofing blanket within the walls before entering the cabin, the heated or cooled air keeps walls and window areas at approximately body temperature.

Because of the plane's huge size and the subzero temperatures of the stratosphere, it was decided to install a complete, independent, air conditioning system similar to those used in buildings on the ground. This has not been done before because of the weight factor, which has now been largely overcome, and because the Stratocruiser's efficient design left extra room and weight available for extra comfort and safety.

Operating with the air conditioning system is the altitude conditioning system of cabin pressurization, which permits the cabin to be maintained at approximately sea level atmospheric pressure at all altitudes from sea level to 15,000 ft. At an actual altitude of 25,000 ft, the cabin is maintained at a comfortable pressure equivalent to an altitude of 5500 ft. Conditions of an 8000 ft altitude can be maintained when the plane is at an actual 30,000 ft.

How to SERVICE

PACKAGE BOILERS

KALMAN STEINER, of C. Hoffberger Co., Baltimore, member of HPAC's board of consulting and contributing editors, author of authoritative books on fuels and burners, explains in this practical, how-to-do-it article the routine of servicing oil burners on package boilers and brings out the differences as compared to the procedure for standard industrial oil burners

PACKAGED BOILERS, by combining boiler and burner into a single piece of equipment, confront the service and operating engineer not only with a new development in oil burner apparatus but also with a complete boiler plant including a system of mechanical draft.

What is this newcomer amongst the time honored, established, and conventional steam generating systems? What is the package boiler? Briefly, it is a combination of steam generator or boiler, fuel burner (either oil or gas), mechanical draft system, condensate return and feedwater makeup system, with the interconnecting piping, wiring, and oil preheating (when necessary) factory assembled and tested and shipped out ready for connection to the customer's utilities (water, steam, fuel, blowdown, and electric power lines). The package minimizes the amount of installation time and material to the essentials; it usually needs only a simple exhaust pipe to conduct combustion gases away. The boiler type is usually a modified scotch marine, which requires a minimum of headroom and hardly more foundation than a smooth and level concrete slab of adequate thickness to support the weight.

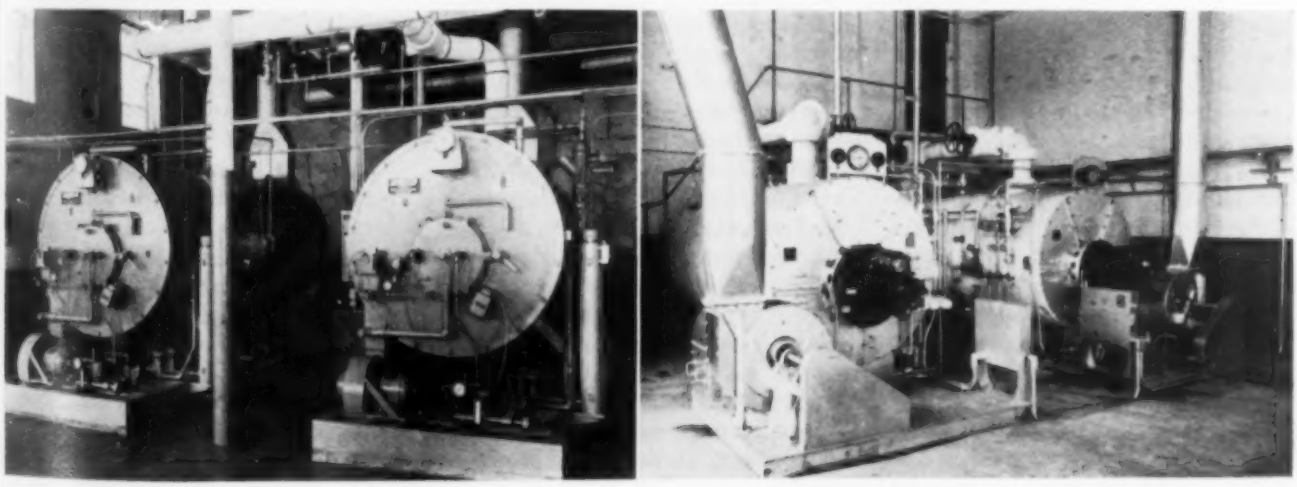
Package boilers, for the most part, are high pressure steam generators but may also be built as low pressure boilers or as direct fired water heaters. The firing means is always automatic. While many are built for burning gas fuel, or for combination gas and oil burning, this article will discuss only oil fired units.

Four distinct types of oil burners are used: for burning light oil, the pressure atomizing burner; and for burning heavy oil, a modified horizontal rotary burner, or an air atomizing burner, or another form of pressure atomizing burner. The distinctive arrangement of each burner type to meet the special needs of a package boiler will be brought out below.

Selecting a Package Boiler

In selecting a package boiler for a plant, the load to be carried should be estimated generously, and a size selected that allows for piping and pickup loss, radiation, and—if possible—future expansion of load. Unlike conventional boilers, which are usually rated on the basis of 10 sq ft heating surface constituting a horsepower of capacity, package

Left—**Two 100 hp package boilers, fired with heavy oil, at a shoe manufacturing concern.** *Right*—**After the units are hooked up and ready to start, it is important to test a number of devices before operating**



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boilers are rated according to their greatest possible output, which is at least twice the rating of a conventional boiler. Hence, a package boiler has little if any reserve, whereas a conventional boiler has a very wide margin of reserve for overload.

Suppose, for instance, that a laundry had an equipment load totaling 63 boiler hp and a heating plant load of 3200 sq ft EDR or 23 boiler hp, a total connected load of 86 boiler hp. To this should be added at least 25 percent for piping, pick-up, and radiation loss, raising the total to 108 boiler hp. If there is any likelihood that new or additional equipment will be purchased in the foreseeable future, allowance should be made for that also. For the existing load, a package boiler rated for about 125 boiler hp should be selected. By contrast, a conventional boiler rated about 70 hp, if set with an adequate combustion volume, would be a good selection for the same load.

Use Good Steamfitting Practice

A package boiler should be installed in conformance with good steamfitting practice and the applicable rules and regulations. Immediately after the steam outlet flange there should be a main shutoff valve, and all branches—whether high or low pressure—should be taken off after this main shutoff.

There have been cases where pressure reducing valves for the heating system were connected to the boiler ahead of the main shutoff, on the theory that the high pressure system could be shut off without interfering with the heating of the building, but that practice is wrong. The purpose of the main shutoff is to prevent flow of steam from the boiler when it is closed. Some forms of valves, called stop and check valves, not only stop flow of steam from the boiler when closed but prevent flow of steam into the boiler even though the valve is not closed. These stop and check valves are especially important where two or more boilers are serving the same system; a boiler taken off the line automatically becomes disconnected from the steam main as its pressure drops below the main pressure.

In the typical package unit, the oil burner has been installed on the boiler at the factory, there remaining only the field operations of connecting the fuel lines from the storage tank, the cold water makeup and condensate feed lines, the steam main, the blowdown, and, in those units employing electric-gas ignition, the gas service for ignition. As to wiring, the factory assembly includes panel board connections to the motors and controls, but of course in the field a power service must be brought into the panel board. In so doing, a few points should be observed. For example, the wires should be sized correctly to handle the burner motor, feed pump motor, mechanical draft motor, and electric preheater; a remote control switch is required in many localities, which can be in the form of a power switch in the line being run to the unit, if the run can conveniently be routed to a point favorable to location of the remote switch.

Important to Test Before Operation

After the unit is hooked up and ready to start, it is important to test a number of devices before attempting to operate. Because the unit has been tested at the factory is no guarantee that some disturbance has not occurred during shipment or installation. Despite care in packing, some of the more delicate control apparatus may be jostled out of adjustment. A rapid checking will reveal what needs attention.

Most package units are wired and equipped with special switches that enable one to energize individual pieces of apparatus without placing the entire system in operation. Thus, in sequence, it is possible to run the mechanical draft fan, boiler feed pump, ignition system (and electronic flame safeguards, if used), burner motor, and pump. In like manner, it will be possible to test the float switch of the boiler level control with its three circuits: pump motor starter, low water burner cutout, and low water alarm; the main steam pressure switch which starts and stops the burner, the variable flame pressure switch (if used), the fan lockout switch (which closes the burner starting circuit only when the mechanical draft fan is operating correctly). All these separate devices and circuits must be verified correct or made correct before any attempt is made to start the burner.

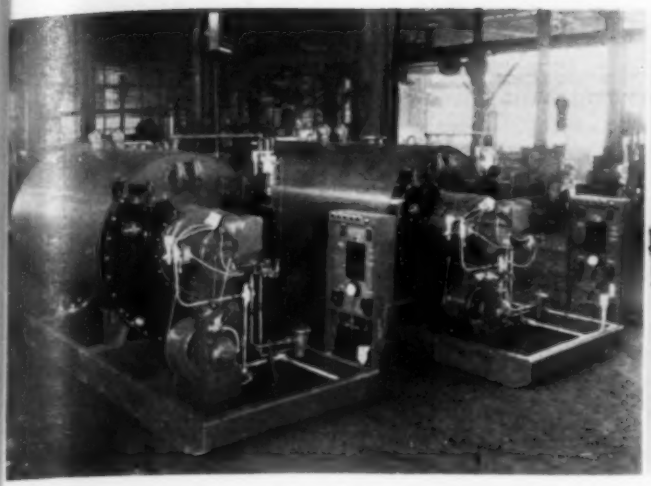
Check Ignition and Oil Flame

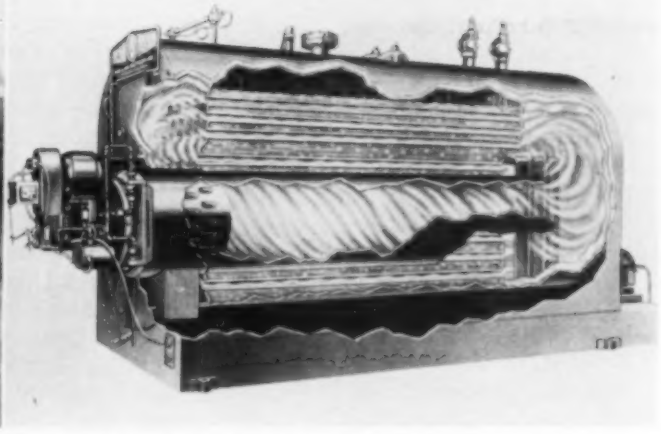
Once the unit is placed into service, the two most important features to check are the ignition and the oil flame. Most ignition systems are either straight electric spark (used principally for light oils) or electric-gas, in which an electric spark ignites a gas flame which in turn ignites the oil flame (this method is used almost exclusively for heavy oils). In the absence of gas for ignition of heavy oil, a spark-ignited light oil flame can be used.

It is possible by means of modern electronic safeguards to prove the establishment of the gas flame before the main fuel valve can open, but with systems lacking electronic safeguards of the gas pilot, and with systems using electric ignition, the main fuel valve can open even though the igniting means is not functioning, thereby permitting unburned fuel to enter the combustion chamber during the time interval required for the combustion safeguard to induce shutdown, which can be as long as 80 sec. The vital importance of the ignition system is obvious, and great pains should be taken to verify that electrodes are correctly placed, that porcelain insulators are clean and sound and free from cracks, that high tension cables are properly equipped with connectors and other fasteners, and that the ignition transformer is correctly mounted and in good condition. Some package units are equipped with special testing switches and circuits which enable checking and proving the ignition without allowing the main fuel valve to open, in order to establish with certainty that the ignition is not only satisfactory but is flawless.

Flame Adjustment Technique Varies

It is in the technique of flame adjustment where the package boiler differs most sharply from conventional oil burner applications. Combustion occurs in a tube of small diameter with a sealed front, permitting at best only a tiny aperture with some sort of transparent cover for seeing the flame. In many cases, the operator cannot possibly see how large the flame is by the ordi-





Left—**Package boilers confront the operating and service engineer not only with a new development in oil or gas firing apparatus but also with a complete boiler plant, including a system of mechanical draft.** *Right*—**The approximate path of the combustion gases, indicating the turbulence attained in the combustion tube, is illustrated in this phantom view**

nary process of opening a firing door or other large port. There should also be an observation port at the rear end of the combustion tube, allowing the operator to see the actual fire. The best guide to flame size is the exit gas temperature, and most units have a permanent thermometer attached to the exhaust pipe for this reason.

What the Stack Temperature Indicates

For high pressure units carrying moderate load, the stack temperature should not exceed 500 F. Normal load conditions might run the exit gases between 500 and 600 deg, and heavy load above 600. Higher temperatures than those indicated, for any given load condition, indicate that the flame is too long, or the tubes are sooted, or the baffles between tube passes are leaking. Just which abnormality is indicated depends upon the immediate past history. With clean tubes and a new installation, clearly a high temperature means too high a firing rate. After a period of use, a gradually increasing stack temperature should mean the tubes need cleaning. A sudden increase in prevailing stack temperature, especially when the tubes are known to be clean, may mean the baffles need resealing, provided of course that the firing rate is known to be normal.

How to Adjust the Fire

Procedure for adjustment of the fire varies with the type of unit, especially the type of burner.

The simplest form of burner is the pressure atomizing nozzle for light oils, which requires, essentially, an oil pump, pressure regulator, nozzle, and fan. In one such make, the assembly carrying the fuel pipe, nozzle, and electrodes must always be set each time the burner is serviced, to establish correct alignment of nozzle tip, electrodes, and baffle plate with respect to each other and with respect to point of entrance into the combustion tube. The gun or blast tube may be considered to enlarge to the diameter of the combustion tube in a plane marking the beginning of the latter. The nozzle face is to be about ½ in. inside the gun before the plane, the baffle plate to be about ¼ in. inside the combustion tube after the plane. The electrodes lead the nozzle face by almost ½ in., or almost touch the baffle.

The baffle has a center hole through which the oil spray enters the combustion tube, and has also a series of slots running axially, some starting at the center hole and running part way toward the periphery, and others starting at the periphery and running part way toward the center hole, alternate slots being slanted at opposing angles. The air supply is thus split into three portions; some mingles directly with the oil spray passing through the center hole, some flows through the slots and imparts considerable turbulence because of the reversal of slant in alternate slots, and the remainder and largest portion streams through the ¼ in. clearance between the baffle plate and the end of the blast tube around the entire circumference and sweeps the flame along the tube without permitting impingement. The most important adjustment is the ¼ in. gap, and this relationship must be checked both before inserting the assembly and afterward by sighting through the observation port. A gap less than ¼ in. results in smoke; a greater gap takes the center hole too far from the nozzle and causes oil spray to impinge on the baffle plate.

Probably the most common form of burner used in package boilers is the horizontal rotary, adapted to the special conditions prevailing in these units. Whereas conventional applications under natural draft burn fuel at a combustion rate of between 25,000 and 40,000 Btu per cu ft combustion space, in the confined combustion tube of the mechanical draft package unit the combustion rate exceeds 150,000.

As in the natural draft model, two air supplies are needed—primary and secondary—the former to support atomization, the latter to complete combustion. The primary air pressure must be rather high compared to the secondary supply, and so a separate fan is mounted on the burner shaft, just as with the conventional application to natural draft settings. The secondary supply is introduced in a complete circle around the circumference of the combustion tube.

Adjustment of the fire involves synchronizing oil feed, primary air, and secondary air at all positions of the variable fire controller. There are three forms of variable fire control: low fire start, high-low including low fire start, and modulat-

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ing including low fire start. The complexity of adjustment increases in the same order. Obviously, if the burner operates at mixmum fire at all times except when starting, only the high fire adjustment is important. In high-low control, only two positions of the controller need be of concern in servicing. But in full modulating control, the synchronism must be maintained through the full range between maximum and minimum size fire.

Air-Oil Ratio of Special Importance

Maintenance of the correct air-oil ratio is important, of course, from the viewpoint of efficiency, but certain developments in control application bring in another factor, pertaining to the combustion safeguard. Where flame detection is by means of convection heat or radiant heat, as in older forms of stackswitches, a smoky flame did not bother operation too much. But with modern electronic systems, the flame safeguard depends upon incidence of light upon a photocell, and a smoky flame will not emit sufficient light to actuate the photocell circuit, resulting in burner shutdown. While all these remarks apply to conventional boiler installations, the peculiar conditions prevailing in the package unit accentuate the need for precise and smooth flame modulation.

Almost all package units designed for burning No. 5 or No. 6 oil embody preheating, even though the same burner in conventional application burns No. 5 oil cold. Again, the special combustion conditions of the narrow diameter tube compel deviation from standard practice.

The horizontal rotary, in sizes above 7 or 8 gph, is easily able to atomize and burn most No. 5 oil in commercial viscosity limits without preheating, but to insure perfect atomization and rapid combustion, it has been found necessary (or at least desirable) to preheat this grade when used in the boiler-burner unit. Two heaters are provided—an electric heater to furnish warm oil on a cold boiler, and an exchange heater (usually using steam for heating medium) to take over after the boiler is carrying load.

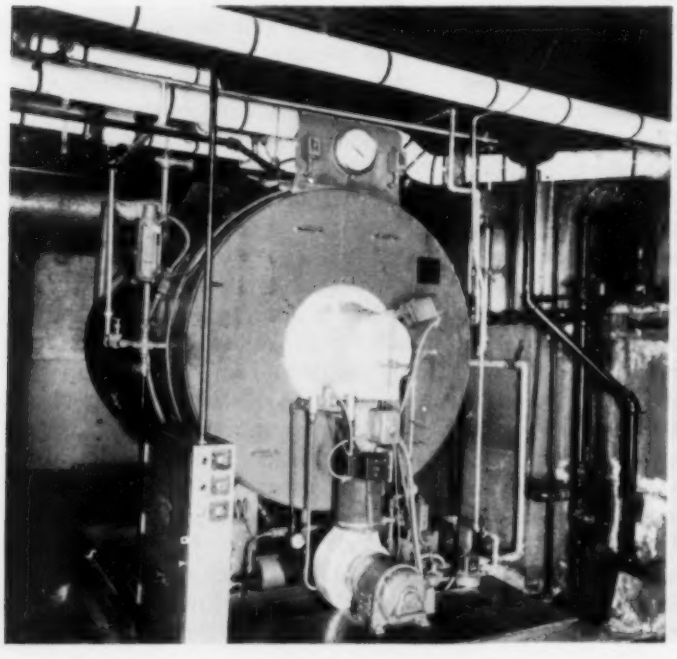
The electric heater thermostat not only regulates oil temperature, but includes a cold oil lockout circuit, delaying starting of the burner until the oil is warmed sufficiently by the electric heater to assure a safe start. The exchange type heater should also have a temperature regulator, since high pressure steam can heat oil to a temperature much higher than required.

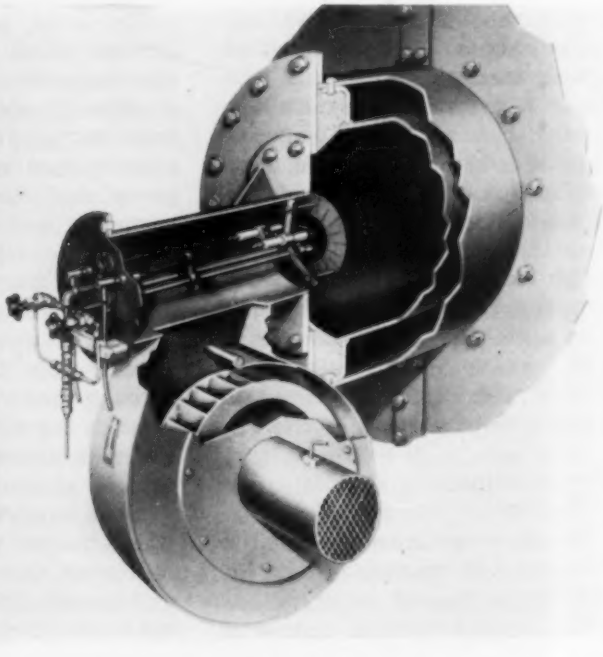
While the subject of oil preheating is fairly complex and requires a consideration of viscosity, viscosity scales, and viscosity change with temperature, it can be said that the average No. 5 oil should be heated to about 150 F, and the average No. 6 oil (if there *is* such a thing as an average No. 6), to between 180 and 200 F. It should be explained that in the confined combustion tubes of the package unit, the viscosity of the fuel delivered to the burner should not exceed 200 sec Saybolt Universal, and should preferably be closer to 150 sec. The temperature at which a given oil reaches those viscosity limits depends upon the nature of the oil, and such information can be had from the vendor.

The routine of servicing oil burners on package boilers resembles very closely the procedure for standard industrial burners, a summary of which was presented in an article in the February HPAC. The important differences have already been brought out above. It might be well to add that the mechanical draft fan should receive the benefit of careful maintenance, especially lubrication, and that when the draft is induced and—as a consequence—the fan is handling hot gases, the adequacy of lubrication becomes even more important.

Among other maintenance items to be observed are treatment of feedwater; periodic internal inspection of the boiler; cleaning of the oil heaters; and checking up the safety controls, including flame safeguards and the low water cut-out.

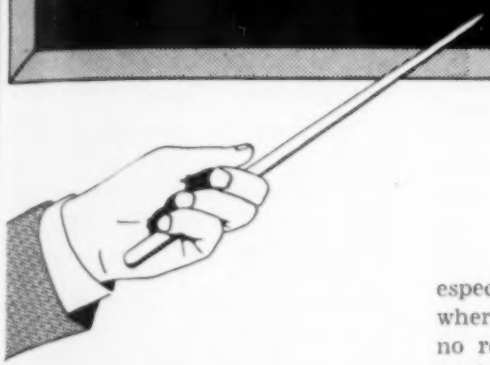
***Left*—Low pressure 100 hp unit recently installed at a bottling plant for furnishing steam primarily for heating water for the plant's bottle washers. *Right*—This detail of one type of package boiler shows the pressure atomizing nozzle carried on the baffle plate assembly, as described in the text**





BASIC PRINCIPLES OF PIPING

(A Review of Fundamentals)



By Herman Vetter

Consulting Engineer, Los Angeles

GOOD REFRIGERANT piping design depends upon a thorough knowledge of hydraulic and vapor piping.

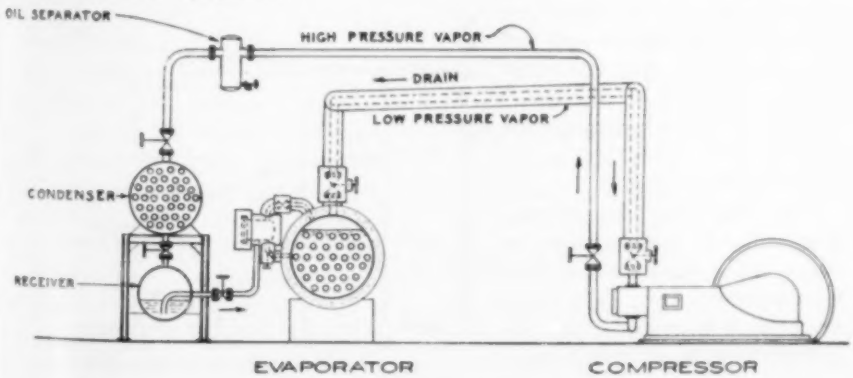
Refrigerant piping can be separated into three main sections—liquid piping between condenser and evaporator; low pressure vapor piping between evaporator and compressor; high pressure vapor piping between compressor and condenser. Fig. 1 represents a simple refrigerating system and shows the essential pipe lines.

Before designing a piping system, an analysis should be made of the compressor, condenser, and evaporator design because refrigerating machinery design does not follow a standard pattern as is the case with steam machinery. This is especially true with evaporators, where imagination apparently has no restraint. Therefore, a concise analysis will be given of compressor, condenser, and evaporator design

Refrigeration is the removal of heat and is effected by the evaporation of a liquid called the refrigerant. Refrigeration is effected by the latent heat of evaporation of the refrigerant, which is expressed in Btu per lb. Therefore, the capacity of the refrigeration system is determined by the weight of the refrigerant circulated.

If the cost of refrigerants were very low, no equipment would be necessary except the evaporator and a large supply of refrigerant in liquid form. In such a scheme, the liquid refrigerant would be evaporated for its cooling effect, and then wasted. The cost of a refrigerant, however, is too high for it to be used only once; therefore, means must be provided to liquefy the refrigerant vapor leaving the evaporator so that it can be re-used. This operation is accomplished by passing the refrigerant vapor from the evaporator through a compressor and raising its pressure where it will condense at the temperature of the available condenser water.

Fig. 1—Simple refrigerating system, showing the essential pipe lines. Its success depends upon the proper piping as much as it does upon the proper selection of the refrigerating equipment



Vapor Entering Compressor Should Be Near Saturation

The efficiency of the compressor is affected by the pressure drop in the line between the evaporator and the compressor and in the line between the compressor and the condenser. The lower the pressure drop, the greater will be the compressor capacity, the higher its efficiency, and the lower the unit horsepower. When vapor is at saturation temperature it is at its greatest density; therefore, the vapor entering the compressor should be as close to its saturation temperature as possible.

There are two major points to bear in mind; one is pressure drop, and the other is superheating of the vapor entering the compressor. These are inter-related, because pressure drop represents power loss due to friction and friction causes superheat.

The pressure drop of the vapor through the compressor is determined by the compressor designer. If, after analyzing the rated compressor speed and velocity of the vapor through the compressor, it is

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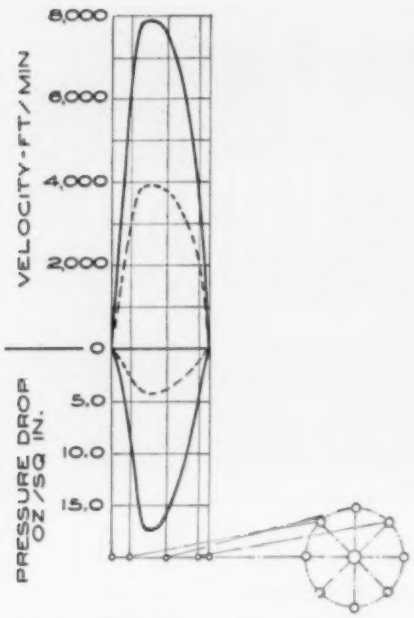


Fig. 2—Velocity and pressure drop fluctuations with a reciprocating compressor. The broken lines show the fluctuations if the compressor speed were reduced 50 percent or the line size increased 100 percent over the speed and size assumed for the full lines

evident that the velocity or the pressure drop is too high for efficient operation, the plant designer should specify a lower compressor speed, one consistent with good economical operation.

With reciprocating compressors, there is a large variation in the time-rate at which vapor is drawn into the compressor during each intake stroke. This is illustrated in Fig. 2. During the first quarter of the intake stroke, 17.4 percent of the vapor is drawn in; in the second quarter, 39.0 percent; in the third quarter, 31.6 percent, and in the fourth and last quarter, 12.0 percent. At the beginning and end of each intake stroke, the vapor velocity is zero and reaches its maximum before reaching the halfway point.

The velocity and pressure drop curves in Fig. 2 were plotted for a compressor having a piston swept displacement of 2.48 cu ft per revolution, operating at 180 rpm, and having a 4 in. intake nozzle. If the size of the pipe line from the main header were the same size as the intake nozzle and if the compressor were operating at 100 percent volumetric efficiency, the mean vapor velocity during the first quarter would be 3,514.64 fpm; in the second quarter, 7,875.64 fpm; in the third quarter, 6,382.77 fpm; and in the fourth quarter, 2,423.84 fpm.

In Fig. 2, the full curved lines represent the velocity and pressure drop fluctuations for the above stated conditions. The broken lines indicate what the velocity and pressure drop fluctuations would be if the compressor speed were reduced 50 percent or if the line size were increased to 6 in.

The curves in Fig. 2 are based on theoretical conditions; that is, the conditions that would exist if the operation were accomplished without losses. In actual practice, a modified result would be obtained. For instance, when the compressor speed is 180 rpm, there are 360 intake strokes per minute if the compressor is either a two cylinder vertical single acting or a single cylinder horizontal double acting type. As there would be 360 strokes per minute, each stroke would have only 0.166 sec to fill the cylinder with vapor.

In this brief period of time, it would not be possible for the vapor to start from zero velocity, reach a velocity of 7,875.64 fpm, and return to zero. The vapor could reach this velocity during the first few revolutions when the compressor is started up. After the inertia of the vapor has been overcome and the vapor is in motion, it will continue in motion at varying velocities as long as the compressor is in operation.

The larger the pipe line to the compressor, the lower will be the velocity and the nearer the pressure drop variations will approach a straight line; therefore, the higher will be the compressor efficiency.

Effect of Superheat of Vapor

In order to show the effect of superheat of the vapor entering the compressor on capacity and power, Fig. 3 has been prepared. These curves were plotted for standard ton operating conditions and on the assumption that the volumetric efficiency of the compressor is 75 percent when operating with saturated vapor entering the cylinder.

The ideal operating condition would be for the vapor to enter the cylinder at saturation temperature. This, however, is seldom practical because there is too much danger of carrying slugs of liquid refrigerant over to the compressor. This is a dangerous condition because refrigerants are solvents and the liquid refrigerant would flush the lubricating oil from the cylinder wall. Most compressors are designed with close clearances between the top of the piston and the cylinder head and are fitted with safety heads yet a slug of liquid could cause the cylinder head to be blown off with the resultant danger to life and property. This is not a remote possibility, and has occurred on too many occasions.

Five Principal Condenser Types

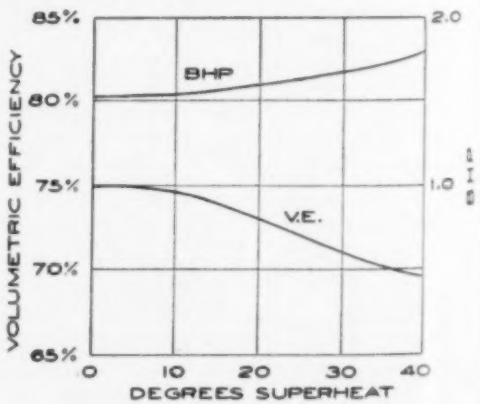
There are five principal types of condensers: (1) atmospheric, (2) double pipe, (3) horizontal shell and tube, (4) vertical shell and tube, and (5) evaporative.

Atmospheric Condenser — This condenser consists of coils placed in a drain pan. The condenser water is directed over the coils in either a thin film or in the form of spray. This type of condenser is easy to keep clean and has good efficiency as the condensing surface is benefited by the evaporative effect of the water film on the condenser surface. The main objection to its use is the amount of space required.

Double Pipe Condenser — This consists of a series of coils made up with a water tube placed inside of another tube, the space between the two tubes forming a passage for the flow of refrigerant. The inner tube might be 1¼ in. pipe and the outer tube 2 in. pipe.

Horizontal Shell and Tube—This is constructed of a shell with a tube sheet on each end. A nest of tubes is inserted and the tube ends

Fig. 3—Effect of superheat of the vapor entering the compressor on capacity and power is illustrated by these curves



fastened to the tube sheets by rolling or welding. The tubes might be 1¼ or 2 in. OD and of 10 or 12 ga. Water heads are bolted to the tube sheets. These heads are fitted with baffles so that the water can flow through the tube nest in a series of passes.

Vertical Shell and Tube—This is constructed with a vertical shell with a tube sheet on each end. The top tube sheet is fitted with a water distributing box and the condenser is set over a concrete water sump. The condenser water is circulated by pumping water into the water box at the top and the water flows down through the tubes into the sump.

Evaporative Condenser—This consists of an atmospheric condenser and a water cooling tower combined in a compact unit. The condenser coil is placed within a metal housing, water is sprayed over the coil, and air is drawn through the housing by means of the fan. This type of condenser requires a minimum amount of space and has proved quite efficient. Due to its compactness, this type of condensing surface may be hard to keep clean unless the condenser water is treated to prevent scale formation.

Methods of Oil Separation

Some means must be provided to remove the oil carried over from the compressor to prevent it from settling in the evaporator and thus reducing its capacity. There are two methods in common use; one consists of a shell placed in the discharge line fitted with a corrugated baffle, the oil being separated by forced contact with the baffle; the other consists of a shell and tube similar to the horizontal shell and tube condenser, the oil being separated by contact with the water cooled tube surface.

Many Evaporator Designs

While the styles and designs of evaporators are without number, yet the bases on which they operate are limited to two. The refrigerant effect is either produced by circulating liquid refrigerant in spray form through the evaporator, or by flooding the evaporator with liquid so that all or nearly all of the heat transfer surface is in contact with liquid refrigerant.

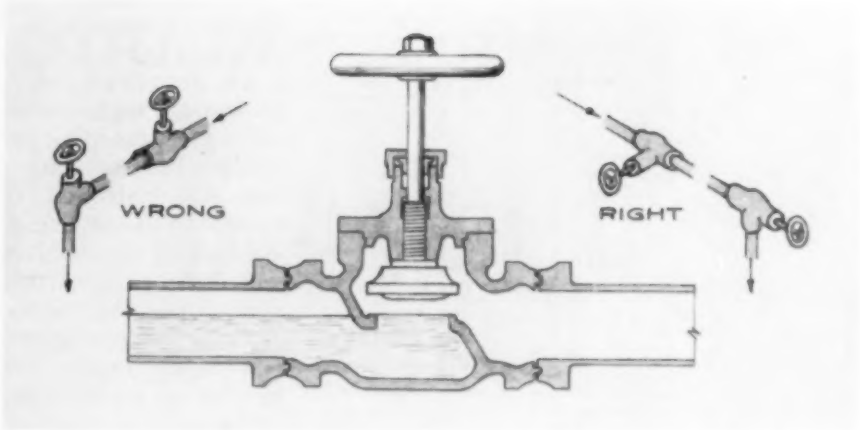


Fig. 4—Wrong and right ways of installing globe and angle valves in drain lines. Valve should be installed so that seat will not form a dam to restrict the flow of liquid and prevent the flow of vapor

The success of the refrigerating system depends as much upon the proper design and installation of the piping as it does upon the proper selection of the refrigerating machinery. We must therefore know the characteristics of the various pieces of equipment as well as the kind of duty expected from it. For instance; is the load demand steady or fluctuating; do the compressor, condenser, and evaporator meet the load requirements; are the various parts of the equipment in proper balance for satisfactory and efficient operation?

If the selection of the refrigerating equipment is under the control of the piping designer, these questions should be answered before the equipment is selected. If, however, the piping designer has no control over the selection of the refrigerating equipment it becomes his duty to design the piping and install such additional equipment as may be necessary to safeguard the machinery and its operation.

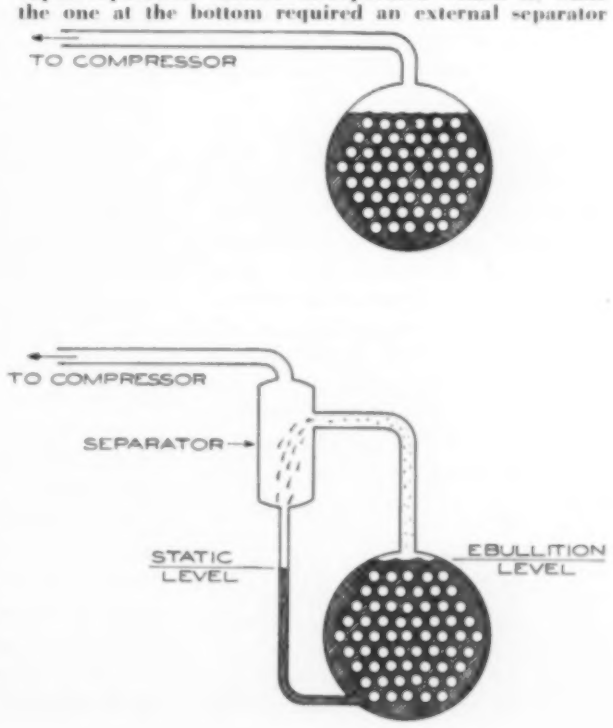
Liquid Piping

The high pressure refrigerant vapor is condensed by contact with the water cooled surface in the condenser. This liquid is drained from the condenser and flows into a receiver. The function of the receiver is to regulate the flow of liquid refrigerant to the evaporator, by storing some of the liquid during intervals of offpeak operation.

The piping between the condenser and the receiver must provide free drainage; it must also provide free passage of vapor from the receiver back to the condenser. When the flow of liquid to the evaporator is retarded due to reduced demand, the liquid level in the receiver rises; therefore, the vapor above the liquid in the receiver must be free to flow back to the condenser to prevent a trapped gas pocket.

Valves in the drain line between the condenser and receiver should

Fig. 5—The evaporator sketched at the top has sufficient vapor separation surface incorporated within it, while the one at the bottom required an external separator



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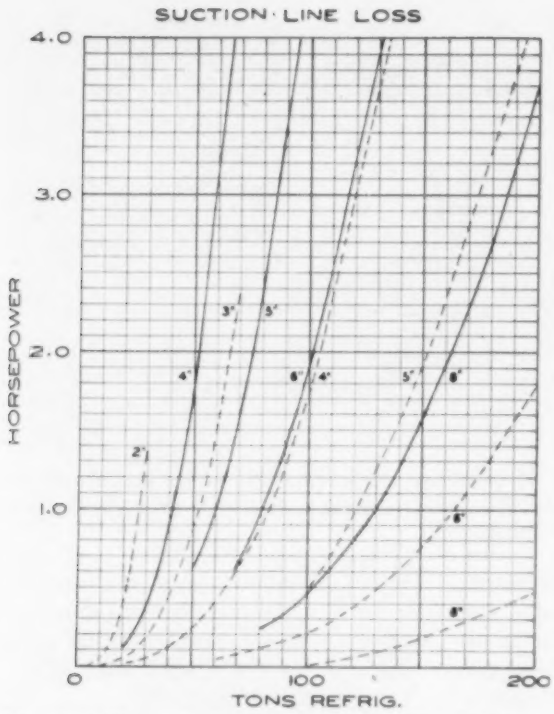


Fig. 6—Effect of pipe line velocity. The full lines are for ammonia evaporator pressure of 5 psi ga and the broken lines for 25 psi. The power is for each 100 ft of pipe line

be installed so that they do not form a trap. The typical design of globe and angle valves is shown in Fig. 4. In these valves, the valve seat is located at or slightly above the center line of the pipe, and when the valve is placed in a horizontal line with the valve stem vertical, the valve seat forms a dam which restricts the flow of liquid and also prevents the flow of vapor past the valve. Fig. 4 shows the right and wrong ways of installing globe and angle valves in drain lines.

The liquid piping between the receiver and the evaporator does not present any special problem because the liquid flows through the line under pressure. Care should be taken that this line does not pass through an area where the air is at a higher temperature than the liquid. If heat is added to the liquid refrigerant before it reaches the evaporator, this additional heat must be removed by refrigeration with the consequent loss in efficiency.

Low Pressure Vapor Piping

The low pressure vapor piping is the most important section of piping in the entire refrigerating system. Fully to realize its importance, the fundamentals of refrigeration must be understood.

As previously described, the refrigeration effect is produced by the evaporation or latent heat of a refrigerant. If —through faulty design —a portion of the liquid refrigerant is carried away from the evaporator in the form of wet saturated vapor, the portion of refrigeration effect of the liquid so carried away is a definite loss in the capacity of the plant. A sudden surge in the load on the evaporator, or an additional compressor put on the line too rapidly, may result in priming of the evaporator. Therefore, low pressure vapor piping should slope toward the evaporator so that—in the event of priming —the liquid can drain back into the evaporator.

Before designing the low pressure pipe line, the evaporator design should be analyzed to determine if sufficient space has been provided for the separation of the vapor from the evaporating liquid. If adequate space has not been provided, then a separator should be installed in the line with provision for either returning the trapped liquid back to the evaporator or with a liquid cooling coil in the separator for precooling the liquid refrigerant before it enters the feed control valve at the evaporator.

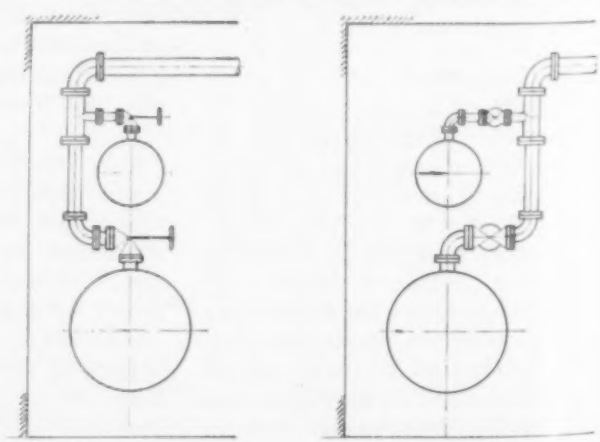
Evaporators that operate on the flooded principle usually control the liquid level by means of a float valve. The liquid level maintained by the float valve is known as the static level. In the evaporator there are two liquid levels; one is the static level and the other is the ebullition level. Naturally, the ebullition level is higher than the static level. The difference between these two levels is controlled by two factors; one of these is the temperature difference between the substance to be cooled and the temperature of the evaporating liquid refrigerant; the other is the amount of surface provided for the release of the vapor from the liquid.

The greater the temperature difference, the more violent will be the boiling action of the liquid. As the amount of heat transfer surface in the evaporator is governed by the temperature difference, the greater the T. D. the smaller will be the amount of surface. Therefore, the smaller the amount of surface, the smaller will be the evaporator in size; consequently, the smaller will be the vapor separation surface unless the evaporator was designed for the specific condition under which it must operate. Fig. 5 shows one evaporator with sufficient vapor separation surface incorporated within the evaporator and one which required an external separator.

The evaporator shown in Fig. 5 is known as the shell and tube type and is used for cooling brine or other fluids in a closed system. There are numerous designs of evaporators for various applications, such as a battery of pipe coils submerged in brine or water, or a coil or battery of pipe coils set in a pan with a distributing trough placed over the coils so that the water to be cooled flows over the surface in a thin film; this type is known as the baudelot cooler. Regardless of the design, the principle of operation is the same.

[*Concluded on page 94*]

Fig. 7—The sketch at right shows the original design for the low pressure vapor piping from two brine coolers and the left sketch shows the re-arrangement. Two elbows were eliminated and the valves were better arranged



Modern Thinking Applied to

DUCT DESIGN

KIRBY WALKER draws upon his experience both in the heating and ventilating field and in wartime research and engineering to discuss duct design. A licensed professional engineer, he was engaged on heat transfer and combustion projects for two large aircraft companies during the war. He has had a wide experience in the heating and ventilating industry, and has supervised manufacturers' laboratory and development personnel. This is the second of a series. In the March issue, straight ducts were discussed, and in April some amplifications and corrections appeared. This month, the subject of elbows is covered, and future articles will take up plotting and predicting pressures; convergence; reduction in area; enlargements; tees and duct branches; duct sizing methods and comments; a summary of points brought out in the series; symbols and formulas used; and references and source material, with comments by the author on their contents

ELLS MAY BE roughly divided into radius ells and square turns. The radius ells are swung on a radius; the square turns are square without a radius, but may use duct turns that give an air path similar to that in a radius ell. The simple radius ell discussed in this section is a radius ell without vanes. A radius ell with vanes, and square turns with vanes, will be discussed later.

Simple Radius Ells

Simple radius ells are affected by the curve ratio, the aspect width, and of course by Reynolds number (*R.N.*). It is important in duct work to know the coefficients for these simple ells. This is necessary because all other ells are made by breaking them down into simple minor ells by means of vanes.

Accordingly, I have taken the liberty of plotting in Fig. 3 rectangular elbow test data given by Madison and Parker in the 1936 ASME Transactions. This figure is presented to illustrate the discussion and some rules for ell design suggested herein.

SYMBOLS

AW = (aspect width) = $\frac{\text{(duct dimension normal to plane of bend)}}{\text{(duct dimension in plane of bend)}}$

CR = (curve ratio) = $\frac{\text{(inside radius)}}{\text{(outside radius)}}$

D = (equivalent diameter) = (feet) = $\frac{1}{3}\frac{\text{(sectional area, square inches)}}{\text{(perimeter, inches)}}$

f = (friction coefficient, straight pipe) = $h\ D/L\ q$

f' = (friction coefficient, shock losses) = $h\ /\ q$

fpm = (actual average feet per minute velocity)

h = (loss of total pressure) = (inches 32 F water column)

$h = q\ f'$; shock losses, obstructions

$h = q\ f\ L\ /\ D$; straight pipe, duct

L = (length of duct) = (feet)

q = (one velocity head of the average velocity) = (inches, 32 F water column)

R.N. = Reynolds number

The curve ratio, CR, is used in this article rather than the old "centerline radius." A centerline radius of 1½, the old reliable standby, is the same as $(CR) = 0.5$. Observing Fig. 3, it will be noted that if the aspect width is kept approximately 0.8 or more, and the curve ratio 0.5 to 0.6, the friction coefficient f may be reasonably taken as 0.14 or 1/7. If a curve ratio above 0.6 is used, simply check for straight pipe friction around the ell and select that or $f' = 1/7$, whichever gives greater friction.

A simple radius ell is one like that pictured in Fig. 3. It should be designed to comply with the following:

1) Make $(AW) = 0.8$ or more.

2) Use $(CR) = 0.50$ to 0.60 and $f' = 1/7$ for 90 deg ells and 1/14 for 45 deg ells.

3) If it is wished to swing a larger radius than 0.60, do so but calculate the straight pipe friction around the centerline as the air flows and use that or $f' = 1/7$, whichever gives greater friction.

This simple ell is one in which there is no substantial change of area or dimension; in general, one of constant dimension around the turn. Where the elbow is round pipe, use the following:

CR	f'
0	0.75
0.2	0.28
0.4	0.22
0.5	0.17
0.6	0.15

Above $(CR) = 0.6$, check for straight pipe friction and use straight pipe drop or f', whichever gives the larger drop. The above figures apply to $(R.N.) = 40{,}000$ to 200,000.

It is apparent that an easy mistake that could be made by a designer on a drawing would be to swing an elbow with a CR of 0.5 and forget that the aspect width was less than 0.8.

The information shown in Fig. 3 is important as it is used below for vaning ells to insure a low friction coefficient when there isn't room to use a simple radius ell of CR 0.5 and AW 0.8 or better.

Vaned Radius Ells

A vaned radius ell is referred to herein as one that is swung on a radius like the one in Fig. 3 but in addition is divided into two or more ells by vanes, each of which is usually swung on the same common center. The reason for using a vaned ell would be one or both of the following, both caused by the

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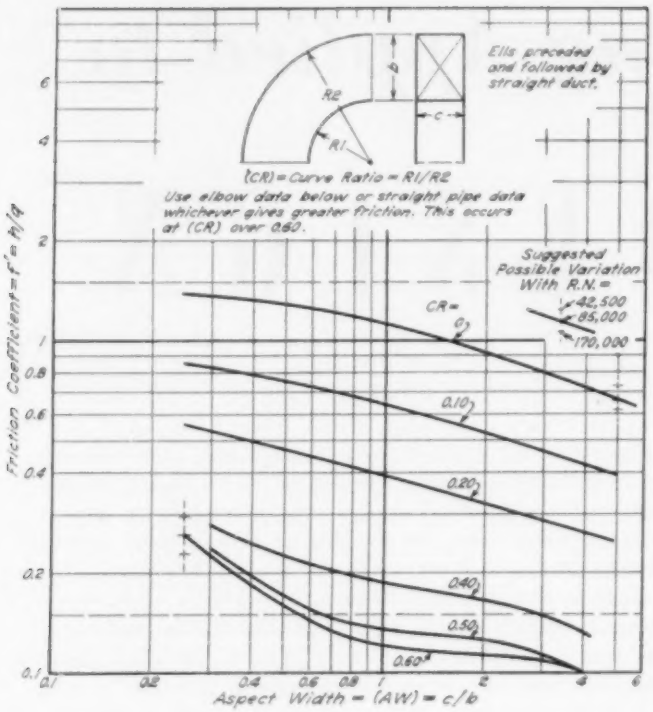


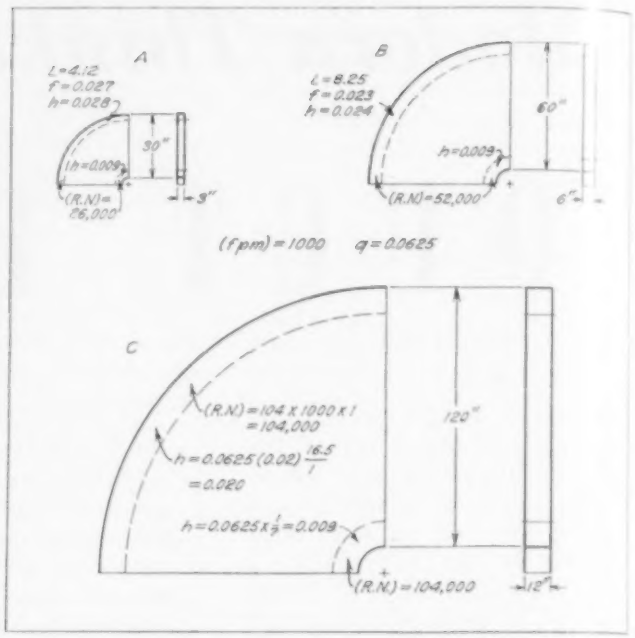


Fig. 3 ***(left)*—Rectangular ell test data. . . . Figs. 4A, B, and C** ***(right)*—Three ells, each with an overall aspect width and a curve ratio of 1/10**

dimensional limitations of the space available:

1) Inner radius must be short making *CR* less than 0.5.

2) The duct dimensions force a turn having an aspect width less than 0.80.

With cramped space, the use of a simple radius ell with *CR* less than 0.5 and/or an aspect width less than 0.8 would give too high a friction coefficient and would give poor distribution of air dumped into the duct following the ell.

In order to consider what might happen when an elbow of very low aspect width is used and to consider vaning such an ell, Figs. 4A, 4B, and 4C were drawn. They show ells each with an overall aspect width and a curve ratio of 1/10. If these ells were used without vaning, reference to Fig. 3 would suggest that f' might be as great as 0.90, a very high figure.

The three ells shown have the same proportions but run from 3 in. by 30 in. to 12 in. by 120 in. All three are considered at 1000 fpm, distributed uniformly through the ell cross section. If we were able to do so, we would require uniform velocity distribution to give uniform distribution in the straight duct attached thereto. This would at the same time require that the pressure loss at the inside corner or short radius be equal to the loss at the outer circumference or long radius.

Referring to Fig. 4, there is shown at the outer circumference a vane giving a long radius ell of aspect width 1, and well over a $(CR) = 0.60$. At the inner corner, there is a vane giving an inside ell of aspect width 1, and $(CR) = 0.5$. The outer ell may then be estimated using straight pipe data and the inner ell may be roughly estimated using $f' = 1/7$.

Using 1000 fpm for each of the three ells shown, and $h = q\ f\ L/D$ for the outer minor ell and $h = q\ f'$ for the inner minor ell, we see that all the way from a 3 in. thick duct up through a 12 in. duct the friction is high along the outer arc. In order to correct this, the friction of the inner ell would have to be increased, possibly by giving it a smaller aspect width.

From the above, we see that for ells with low aspect width, design effort is expended on giving the inner minor ell a friction as great as that of the outer minor ell. By giving all the minor ells the same friction at the same average velocity, we get a good velocity distribution in the attached pipe. For an ell of high aspect width, we vane to get minor ells of reasonable curve ratio to keep f' at a low value.

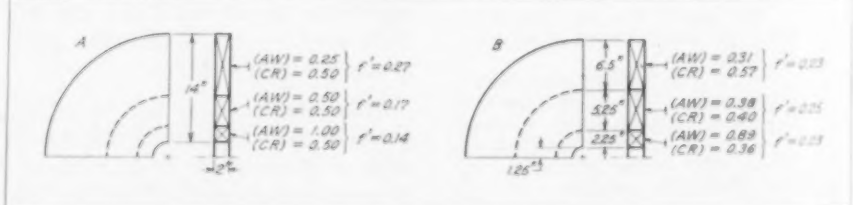
In general, the previously referred to paper on ells by Madison and Parker in the 1936 ASME Transactions recommends vaning an ell so that the minor ells all have the same curve ratio. Accordingly, Fig. 5A is presented to show a 2 in. by 14 in. ell vaned by the use of the chart presented in the above paper.

From the data in Fig. 3, the f' values for each of the three minor ells of Fig. 5A are set forth. It will be noticed that the outer minor is 0.27 and the inner 0.14—obviously too great a discrepancy.

Radius Ell Chart

In view of the above, Fig. 6 is presented. By the use of Fig. 6, the ell in Fig. 5A was redesigned using unequal curve ratios and the results

Fig. 5A ***(left)*—Minor ells with equal curve ratios. . . . Fig. 5B** ***(right)*—Minor ells with recommended unequal curve ratios**



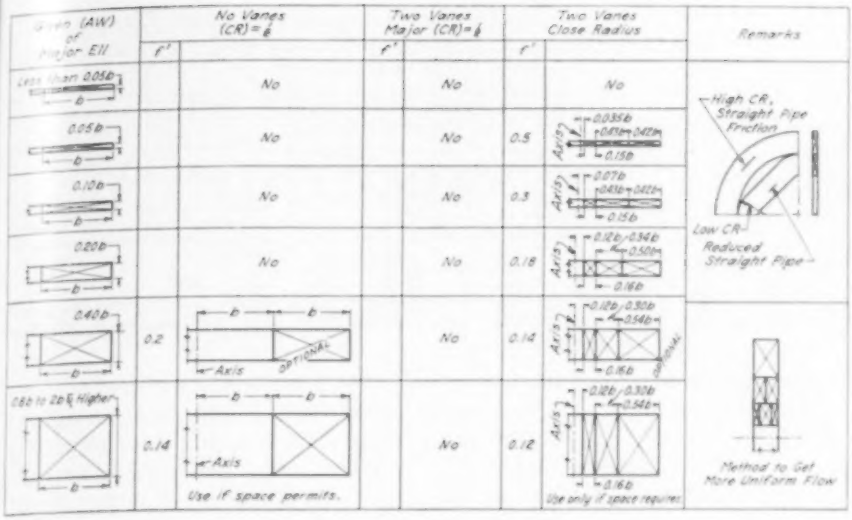


Fig. 6—Radius ells

shown in Fig. 5B. Fig. 6 was laid out by the author for reference purposes, using data from Fig. 3.

In connection with minor ells discharging into ducts where the velocity is the same as in the minor ell, the author believes they will act like simple ells connected to a duct and the data in Fig. 3 are applicable. They are not discharging into the open—i.e., into zero velocity, a plenum.

In using Fig. 6 for selection purposes, refer to information on square turn ells in connection therewith.

Square Turn Ells

Square turn ells are ells made like a box corner, with an outside shaped as in Fig. 8. The outer corner could be swung around on a radius making the ell a radius ell with a curve radius of zero. This makes f' equal roughly 1—obviously too high a value for most practical purposes. If the outer boundary is left a square corner, surprisingly f' is a little less but still it is too great for most purposes.

There has therefore grown up the practice of using a series of small turning vanes at the miter of the ell. These vanes may be mounted in a frame as indicated in Fig. 7, and are a practical way to change duct dimensions. Use of a vaned radius ell would obviously be more involved where duct dimensions are being changed.

The turning vanes used may be classified as the single thick and the double thick. Each is an attempt to break the major ell into a series of minor ells having a reasonable curve ratio and aspect width.

Observing Fig. 8, it will be seen that the double thick vanes give a true curve ratio minor ell. In that shown, $(CR) = 0.5$. f' through the double thick vanes could then approach 0.14 or less and be estimated much as a simple radius ell. Since these ells are not discharging into still air, it is reasonable to suppose each minor ell will act as if connected to a duct. They are discharging into the same velocity, not into a plenum. The disadvantage of either type vane is that the straight pipe drop around the outer path is greater. This extra length is shown in Fig. 8 as *K* to *L* and *M* to *N*. If this straight pipe drop is small compared to that through the ells, then the f' for the major ell could be close to f' for the minor ell.

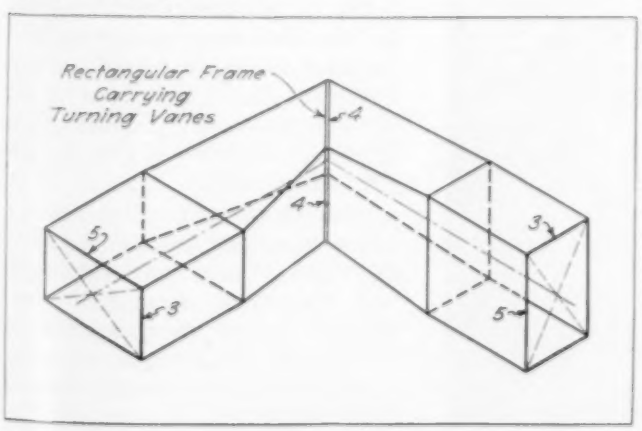
Notice that with the double thick vane the velocity does not drop as it passes through plane Z-Z. With the single thick vane, the velocity is lower as it passes through the plane Z-Z and it will be noted that the single thickness does not give a true radius minor ell.

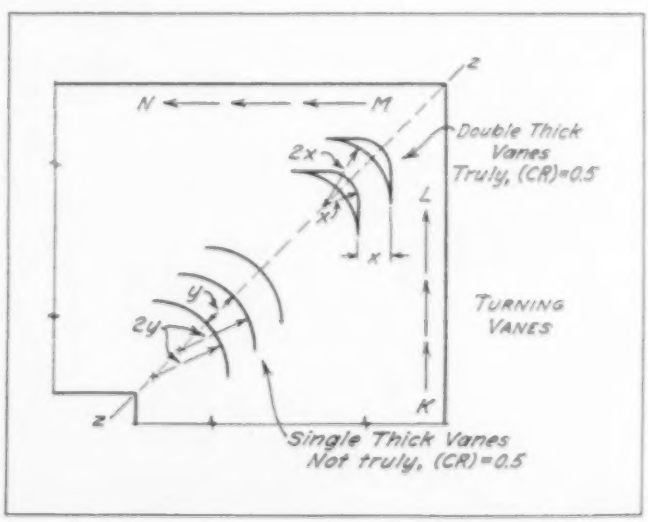
Square Turns— Double Thick Vanes

Where the pressure drop along the outer path is small compared to that through the minor ell, the f' for the minor ell plus an added safety factor should be used. This is reasonable regardless of the aspect width of the major ell.

As more vanes are added to an ell, the dimension, *D*, in the Reynolds number for the minor ell is reduced. If 10 vanes are used, the *R.N.* for the minor may in some cases approach 1/10 the *R.N.* for the major ell. Fig. 2 (page 87, March HPAC) on straight pipe shows that as *R.N.* becomes smaller, f becomes larger. This occurs as you trace any line to the left. A similar effect could happen with an obstruction like an ell. Since data on ells are not available plotted vs. *R.N.*, we can only guess at how much f' would increase.

Fig. 7 *(left)*—Transformation in a square turn. . . . Fig. 8 *(right)*—Turning vanes





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It might be reasonable to use f' for the minor ell 25 percent larger than the f' picked off Fig. 3. This would allow for turbulence produced by sharp edges, etc.

Square Turns— Single Thick Vanes

The single thick type of vane in a square turn fills a convenient requirement in duct work. Again, there is the added length of outer path *K-L, M-N* in Fig. 8 to upset uniform flow through the vanes. More data should be plotted on this type of vane and made available, such data showing f' vs. *R.N.*, taking the *R.N.* in the vane. That would mean using the equivalent diameter between two vanes and the velocity between them.

There has been some rough data available to the author which seem interesting. When analyzing this information, f' seemed to vary according to the number of vanes in a major ell of given aspect width. This has been plotted in Fig. 9. The vanes had a spacing roughly 1 in.

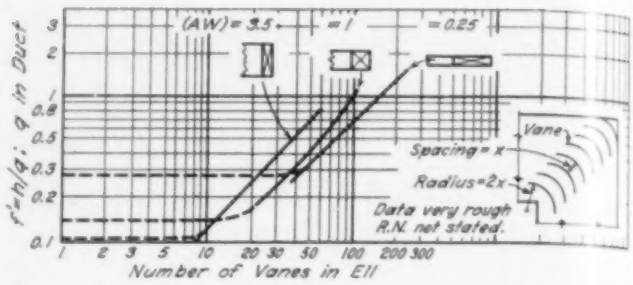


Fig. 9—Square turn, single thick vanes. The dotted lines are for discussion only—solid lines may be used with caution as design data

The dotted lines starting at (number of vanes) = 1 are the author's addition. Using two vanes the ell may ideally be thought of as one with a curve ratio of 0.5. It is reasonable to suppose that f' for the vaned square turn couldn't be less than that for a simple radius ell; hence, the dotted lines.

Fig. 9 is therefore offered for consideration. It does seem to indicate that there is such a thing as putting in too many vanes. In any case, the selection of an ell design should be made after conditions at the ell are known. It may be that a vaned radius ell or a simple radius ell could do a better job. Comparison of Figs. 3 and 6 and 9 would tell.

BASIC PRINCIPLES OF PIPING

[*Continued from page 90*]

High Pressure Vapor Piping

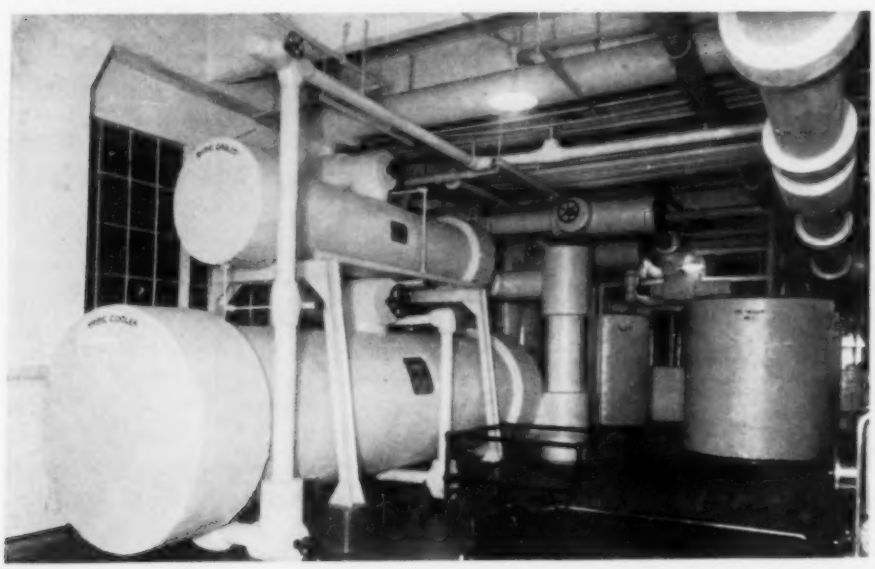
The high pressure vapor piping between the compressor and the condenser carries superheated vapor; therefore, the pipe line can be placed on a level plane if desired. If the high pressure vapor line is long and exposed to low atmospheric temperature, then the pipe line should be sloped so that if part of the vapor should condense it will drain into the condenser. All vapor piping, whether high or low pressure, should be so arranged as to avoid traps in order that oil or liquid cannot collect in the pipe lines.

High pressure vapor leaves the compressor at temperatures ranging between 200 to 300 F; therefore, these lines should be run through well ventilated rooms or preferably outdoors to avoid creating uncomfortable working conditions indoors.

The effect of pipe line velocity is illustrated in Fig. 6. These curves are plotted for two operating conditions. The full lines are for ammonia evaporator pressure of 5 psi ga and the broken lines are for 25 psi ga. The power is for each 100 ft of pipe line. If the capacity of the plant is 100 tons and if it is operated at 5 psi, the difference in cost of line loss between an 8 in. and a 6 in. line would be 1.44 hp per 100 lineal ft of low pressure vapor piping. As most refrigerating plants are operated 365 days per year and 24 hr per day, the difference in cost of operation between these two sizes of pipe lines would be: 1.44 hp × 0.746 kw/hp × 0.01/kw hr = 0.0107/hr. And 0.0107 × 24 hr × 365 days = $93.72/year.

This saving is effected by reducing the pipe line pressure drop for each 100 ft of pipe and does not include the increased compressor efficiency due to the vapor entering the compressor at a higher pressure and with less superheat.

Fig. 8—An example of efficient piping design and pleasing appearance. Fig. 7 illustrates the old and the new arrangement of the low pressure vapor piping shown here



When proper consideration is given to the piping arrangement, not only will the plant operation be efficient but the appearance will be more pleasing. Fig. 8 shows an example of efficient piping design with pleasing appearance.

The initial design of the piping in this plant was changed for both economy of operation and for appearance. Fig. 7 shows one of the changes made in the design. The sketch on the right of Fig. 7 shows the original design.

In making a comparison of these two arrangements it will be noted that two elbows were eliminated and the valves were better arranged. Due to the elimination of two elbows, the pressure drop was less, resulting in increased efficiency of operation.

Summary of Methods for STERILIZING AIR

By Cyril Tasker

Increasing interest is being shown in methods for air sterilization—or "air sanitation." Efforts to achieve pure air appear to be as important—perhaps even more important—than those which have resulted in our pure food and pure water supplies

INCREASING interest in this country in methods for air sterilization—or "air sanitation," which is the term preferred by W. F. Wells—is perhaps sufficient justification to review a comprehensive paper, titled Methods for Maintaining Bacterial Purity of Air, which was presented in London last December before the Institution of Heating and Ventilating Engineers by R. E. O. Williams of the Central Public Health Laboratory, and published in the Journal of the Institution of Heating and Ventilating Engineers, Vol. 16, No. 162, January 1949.

"It may be necessary or advisable to purify the air of a combined space for two general reasons," Dr. Williams began. "The first is to ensure the removal of bacteria that would damage or contaminate material being prepared or treated in the space; the second is to free the air from pathogenic microbes which, if inhaled, or deposited in a wound, might produce disease." At times both reasons hold, and consequently there are wide differences in the standards of air purity required. In the production of penicillin and other antibiotics, almost complete sterility of the air in which cultures are grown is a necessity. During preparation of many therapeutic materials that are to be administered by injection, a high degree of purity is demanded.

Obvious examples of the second type are hospital wards and operating theaters, offices, schools, and public transportation, where persons suffering from respiratory and other diseases frequently disseminate infected material. Though, as Dr. Williams pointed out, there is some controversy among epidemiologists as to the extent to which diseases are spread by the aerial route, it is generally agreed that a low bacterial content is desirable.

Estimating Degree of Contamination

This is not the place to review at any length the various methods suggested for sampling the air in order to estimate the degree of bacterial contamination. The simple method of exposing dishes containing suitable nutrient media and allowing airborne particles to settle on them may give a misleading picture of the total bacterial content since it gives undue prominence to bacteria carried on the larger particles. This method, Dr. Williams suggested, is particularly unsatisfactory in tests of air disinfectants.

The Wells "air centrifuge" and the British "slit sampler" were discussed by Dr. Williams; the slit sampler, or one of its various modifications, has become the standard instrument used in Britain for investigations of airborne bacteria.

"In ordinary occupied places, like offices and schools," Dr. Williams said, "the mean count of bacteria-carrying particles, estimated by the usual bacteriological methods, varies between about 30 and 200 per cu ft. The vast majority of the bacteria are nonpathogenic and most are apparently derived, immediately at least, from clothing. Bacteria are also sprayed into the air from the mouth in talking, coughing and sneezing, but these do not usually form more than 1 to 5 percent of the total flora. Pathogenic bacteria (i.e., those that may produce disease) are generally even rarer. One particular pathogenic bacterial species has, nevertheless, been studied widely in tests of air disinfectants, namely the haemolytic streptococcus. This microbe is responsible for scarlet fever, sore throats, tonsillitis and the like, and is apparently often transmitted from one patient to another by way of infected floor- and blanket-dust.

"Pathogenic microbes are very difficult to recover from the air. In judging the practical value of methods to control the spread of disease, one is forced sometimes to depend on the measurement of the reduction of the *total* bacterial content, which may not in itself be a sufficient achievement since it is the control of the pathogenic organisms responsible for disease that is the real criterion of effectiveness," he said.

"The establishment of the value of a particular method of purifying

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air," Dr. Williams continued, "requires extended trial of its effectiveness *in field conditions*. The variation in bacterial air counts commonly observed in occupied places has been given far less attention than it deserves in reported work on air disinfection, and in very few trials have the differences observed, and attributed to the disinfectant, been considered in the light of the variations due to other factors. This, and varying bacteriological techniques, make statistical evaluation of many tests quite impossible."

Methods for Purifying Air

The methods discussed in Dr. Williams' paper can be briefly summarized as follows: (A) filtration, (B) dilution by ventilation, (C) precipitation by electrostatic force, (D) prevention of spread from floors and clothing by suitable treatment, and (E) killing of suspended microbes by (a) physical methods or (b) chemical methods.

Practically all of the methods can be applied to the air in inlet, outlet, or recirculation ducts, or to the air of the space in question. Dr. Williams suggested that sterilization in recirculation ducts is a relatively inefficient method of reducing the bacterial content of the air of a room since it is difficult to recirculate a sufficient volume of air.

There is little concrete evidence to date on the value of the ordinary type of filter as a bacterial filter. Dr. Williams quoted Bourdillon (recognized as one of the leaders in this field in Britain) who, when studying the use of a filtered air supply for an operating theater used for treating severely burned patients, found it possible, by a suitable combination of filters, to reduce the count of bacteria-carrying particles in the air introduced into the room by 99.5 percent, even at a flow rate of 500 cfm. Bourdillon has also stated that cooling coils may act as quite efficient bacterial filters.

Dr. Williams quoted the pioneer work of W. F. Wells in the field of ventilation and said that experiments are now being made in schoolrooms in England to study the relationship between bacterial count and ventilation.

Though electrostatic precipitation has not yet been extensively tried as a means of reducing the bacterial content of air, Bourdillon has stated that, theoretically, the method can be made as efficient as is needed.

The oiling of floors and fabrics, dealt with at some length in Dr. Williams' paper, will not be discussed here since the method, though quite effective, has little bearing on the work of the ventilation engineer.

Considerable attention was given by Dr. Williams to the use of ultraviolet irradiation for the control of micro-organisms. It is practically impossible, of course, to use direct irradiation of the whole of the space. Irradiation in ducts is not favored in Britain, he said, because of the difficulty of handling a sufficient proportion of the air to have a significant effect on the total bacterial flora of the room.

Indirect radiation of rooms, by the use of low pressure ultraviolet lamps fixed at about 7 ft from the floor and directed towards the ceiling, and curtain irradiation, were discussed at some length. In this country Wells, Buttolph, and others have written extensively on both these methods and the results obtained.

"A great variety of chemical substances, from sodium hypochlorite to incense, have been suggested for use as aerial bactericides. For this purpose," Dr. Williams suggested, "a substance must satisfy a number of criteria, as well as being lethal for bacteria. It must be completely nontoxic for man, even when inhaled continuously over a matter of months or years (clearly a very difficult property to establish); it should be quite inodorous and nonirritant even when liberated in excess of the optimum concentration; it must not corrode metals or attack fabrics and the like; its action should not be too greatly affected by temperature or humidity; it must be readily available at a reasonable cost; and the methods and apparatus used for its dispersal must be simple and foolproof, and susceptible of precise control to avoid the liberation of an excess of the active material. It is not surprising that of all the substances suggested in the past few years only two—sodium hypochlorite and the glycols—have been submitted to satisfactory trial in the field."

Mists of sodium hypochlorite have

This ward in the Childrens' hospital at Philadelphia has ultraviolet barriers or "curtains" protecting the cubicles against penetration of airborne bacteria

been repeatedly shown to reduce the bacterial content of the air, and during the war preparations were made to use such sprays in air raid shelters in Britain in the event of an epidemic of respiratory infection. These mists, however, suffer from several disadvantages. They are not very persistent, they are irritant in high concentrations, drops of the spray may corrode metals, and their bactericidal action is greatly reduced at humidities below 50 percent.

Most of the work on glycols has been carried on in America and Dr. Williams reviewed this at some length. He suggested that perhaps the lack of sufficiently precise controlling apparatus may have been the reason why certain investigators found no bactericidal effects from the use of glycols in a RCAF barracks and why the U. S. Naval Medical Research Unit obtained similar results.

In England, J. E. Lovelock and his colleagues of the Medical Research Council have been studying the use of certain hydroxy-acids as aerial disinfectants. If the results of the preliminary investigations are confirmed, these substances may prove more suitable than the glycols. Some of them are suitable for vaporization from surfaces at room temperatures. Elaborate apparatus is thus unnecessary and maintenance problems are reduced to a minimum.

In spite of frequent claims for ozone as an aerial disinfectant, it has been found that tolerable concentrations are of no value in killing bacteria in the state in which they are normally present in the air.

Is the Expense Justified?

Dr. Williams concluded his paper as follows:

"Whether, by air purification, we can reduce the spread of colds, sore throats, influenza, and so forth, is as yet unknown. It is reasonable to suppose that measures to prevent the aerial transmission of bacteria will have some effect in reducing the spread of disease, but a great deal of research is still needed before we can say how much effect can be expected from any of the various measures, and hence whether the expense of installation and of maintenance can be justified."

In the discussion Dr. Bourdillon said that people often asked him, "If I improve the air in my place shall I stop getting colds?" The answer, he said, was undoubtedly "No!" but that did not mean that it was not worthwhile improving the air. Every improvement in air hygiene is an advance and tends to reduce the severity and possibly the frequency of respiratory infections.

Centrifugal Fans Remove Bacteria

He drew attention to the fact that Prof. Wells had found in 1940 that certain centrifugal fans removed about 90 percent of the bacteria of the air which passed through them. He suggested further investigation of this and that possibly the fan casing might be oiled to aid in bacteria removal.

Downstream of Air Proves Effective

Dr. Colebrook said that in a hospital in Birmingham ventilation equipment designed to give an abundant downstream of air from the ceiling to the floor had proved very effective in sweeping away all particles carrying bacteria which came off the patient as soon as the bandages were disturbed while he was being dressed. Sometimes there were many thousands of such particles not only in the immediate surroundings of the wound but extending to many feet all around.

The original plant, Dr. Colebrook said, had been designed to give 10 changes per hour. It was not certain at that time whether patients would stand that amount of air, but it had soon been found that, provided the air diffused at ceiling level to avoid concentrated downdraft, and was of the right temperature and humidity, they stood it perfectly well, even though they were completely naked. In order to make the plant more efficient, the air change had been stepped up to 20 and 25 turnovers per hour, and since then a second plant had been installed which gave a still higher air flow, but still the patients were not at all worried by the downstream of air. The staff working in the room, even for 4 to 6 hr in the day, found the atmosphere pleasant to work in. He had not heard any complaints of headaches, etc.

Discussing the results obtained in Birmingham, Dr. Colebrook said that the work had been started because very little progress had been made during the past 60 or 70 years in the treatment of burns, as far as the control of infection was concerned. Even as recently as 1941, the only hospital where observations were made showed that more than 80 percent of the patients suffering from burns became infected with streptococci which were important from the point of view of their full recovery—and often from the point of view of their survival.

In spite of the tightening up of the technique of dressings, and the use of penicillin, it had not been possible to reduce the 80 percent by more than a little over half, so he and his colleagues had decided that they must be going on the wrong lines in ignoring the microbes in the air. They knew that the microbes were there, but they had been doing all their dressings, as dressings were done in hospitals all over the world, in the hospital wards. There was no doubt at all, in his opinion, that the wounds frequently became infected from the microbes in the air, so, with Dr. Bourdillon's help, the plant had been installed in the dressing room in the Birmingham hospital to give clean air, and the result had been remarkable. Almost without exception, the transmission of microbes from one patient's wound to another's was prevented. Some 5000 to 6000 dressings had been done in the dressing room in question in the last three and a half years, and during that time not more than about a dozen of the infections which were formerly so common had occurred at the time of dressing. That was a quite remarkable experience to anybody who had worked with burns. It showed that in the future it would be quite unjustifiable to carry out any dressings of open wounds in hospital wards. They must in future be done in clean air, and the experience in Birmingham certainly showed that an abundant stream of filtered air served the purpose in a most convenient way.

Those particularly interested in this field would do well to study the complete paper, which contains an extensive bibliography of 98 references.

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How to Design the Piping for *Conveying Flashing Hot Water*

OUR DISCUSSION of the design of piping for conveying flashing hot water concludes this month with the appendices showing the equations which were used in the examples presented in the April installment. The seven figures, from which precalculated data may be obtained, were published with both the March and April installments.

APPENDIX A—DEVELOPMENT OF A FORMULA FOR CALCULATING THE PRESSURE DROP IN PIPES CARRYING A FLASHING MIXTURE OF STEAM AND WATER

The loss in pressure in a differential length of pipe (dL) is balanced by two forces, friction and inertia. The friction is obtained from the familiar Fanning equation and is written:

$$dp' = 4 f U^2 dL / (2 g V D') \quad \ldots [1]$$

The inertia is obtained from Newton's law of motion, in which force = mass × acceleration. If a unit cross sectional area is considered, the inertia pressure drop may be written as follows:

$$dp'' = (dL/V g) \times (dU/dt) \quad \ldots [2]$$

But $U = dL / dt$, which may be substituted in [2] to give:

$$dp'' = U\,dU / V g \quad \ldots [3]$$

Adding [3] and [1]:

$$dp = dp' + dp'' = (4 f U^2 dL / 2 g V D') + U\,dU / V g \quad \ldots [4]$$

But $U = G V$ and $dU = G\,dV$, which may be substituted above to give:

$$dp = (4 f G^2 V\,dL / 2 g D') + (G^2 dV / g) \quad \ldots [5]$$

Multiply all terms in [5] by $(g / V G^2)$ to obtain:

$$(g / G^2)(dp / V) = (2 f\,dL / D') + dV / V$$

Integrating between limits

$$(g / G^2) \int (dp / V) = (2 f L / D') + 2.3 \log (V / Vi) \quad \ldots [6]$$

The above equation is in consistent units. It is convenient to transpose into the same units in which the problem is usually stated: $D' = D / 12$; $144\,dP = dp$; $G = 40\,M/A$; $f = 0.003$; $g = 32.2$.

$$[144 \times 32.2/1600(M/A)^2] \int dP/V = (0.006 \times 12\,L/D) + 2.3 \log (V/Vi)$$

Divide through by 0.072. Let $B = \int dP/V$ and $C = 31.9 \log (V/Vi)$

$$[40.3\,B\,(A/M)^2] = (L/D) + C \quad \ldots [7]$$

$$[40.3\,B''\,(A/M)^2] = (T/D) + C'' \quad \ldots [7a]$$

In the above derivation, it will be noted that the value for friction factor (f) was taken as 0.003. This is the value recommended by Benjamin and Miller (Their value, $K = 0.012 = 4 f$) [see Flow of Flashing Mixture of Water and Steam Through Pipes, by M. W. Benjamin and J. G. Miller, Transactions of the ASME, vol. 64, October 1942, pp. 657-669]. They determined this coefficient experimentally. It is interesting to note that this value is about what one would expect as it corresponds with a value read from any of the standard friction factor curves, where (f) is plotted against Reynolds number [see Principles of Chemical Engineering, by Walker, Lewis, McAdams, and Gilliland, McGraw-Hill Book Co. third edition, p. 78]. It corresponds, as one would expect, to a very high value of Reynolds number.

In this equation for pressure drop, there are two terms which are rather difficult to obtain. The first term, $B = \int dP / V$ is obtained by plotting the reciprocal of (V) against (P) and integrating graphically the area under the curve. It is believed that (V) should be calculated by using the steam tables and assuming that the fluid expands at constant enthalpy as it progresses down the pipe. Each point on the curve entails a separate calculation, so that altogether it is quite a chore to calculate a single curve. To eliminate this work, a series of curves plotted in Fig. 1 show the value of this integral for all pressures below 600 psi.

The second term [$C = 31.9 \log (V/Vi)$] would also be somewhat difficult to calculate. For this reason, curves are presented in Fig. 2 from which values for C may readily be obtained.

It should be noted that our assumption of expansion at constant enthalpy is valid for long insulated lines where the velocity head is a small percentage of the total pressure drop. This means that it is justifiable where C, in the formula, is small compared to L/D. For short lines, an assumption of expansion at constant entropy would be more nearly correct. Benjamin and Miller [see reference mentioned above] correlated all of their test data with the assumption of expansion at constant entropy. The present author has seen fit to present the data on the basis of a constant enthalpy assumption. It is interesting to note that they state, "However, in the usual case, the density of the mixture will be very

THEODORE E. BRIDGE, a mechanical engineer with the University of Chicago in connection with a project under construction for the Argonne National Laboratory, acquired a wide experience in the design of power and of process piping during 15 years with E. I. du Pont de Nemours & Co.; he has also had experience in the field of very high pressures. In his article, of which this is the third and concluding part, his objective has been to help the "average engineer" in applying theory to the problem of designing piping systems for conveying flashing mixtures of steam and water. It is felt that his discussion represents a significant and practical contribution to the subject of piping

nearly the same whether an isentropic expansion or a constant-enthalpy expansion is assumed." In any case it is believed that, in the range where C is equal to or less than L/D, the constant enthalpy assumption, used in calculating the curves in Figs. 1 and 2, is as good or better than would be the assumption of expansion at constant entropy.

APPENDIX B—DEVELOPMENT OF A FORMULA FOR CALCULATING THE FLOW OF HOT WATER THROUGH AN ORIFICE LOCATED AT THE BEGINNING OF A PIPE

Benjamin and Miller [see The Flow of Saturated Water Through Throttling Orifices, by M. W. Benjamin and J. G. Miller, Transactions of the ASME, vol. 63, July 1941, pp. 419-426] have shown experimentally that no flashing occurs in the throat of an orifice when water at the saturation temperature is passing through the orifice. This means that the same formula may be used for calculating the flow of either hot or cold water. It would appear that the water in the throat of the orifice were supersaturated; as though, in passing through the orifice, it had insufficient time in which to flash into steam. Therefore, the following formula will accurately describe the flow conditions for either hot or cold water, and it makes no allowance for the flashing of any water into steam. The flow equation may be written:

$$M = 3.6\, U\, Ao\, 62.5 / 144 \quad \ldots\ldots [8]$$

From the energy equation (Head loss $= U^2/2g$), we derive an expression for velocity:

$$U = \sqrt{2g\,(Pi - Po) \times 144 / 62.5} \quad \ldots\ldots [9]$$

Substitute [9] in [8]:

$$M = 3.6\, Ao \sqrt{2g\,(Pi - Po)\, 62.5 / 144}$$

$$M = 19\, Ao \sqrt{Pi - Po}, \text{ or}$$

$$Ao = 0.0529\, M / \sqrt{Pi - Po} \quad \ldots [10]$$

The theoretical area Ao calculated from the above formula should be divided by a coefficient of discharge to obtain the actual area of the orifice.

APPENDIX C—DEVELOPMENT OF A FORMULA FOR CALCULATING THE SURGE PRESSURE RESULTING FROM A SLUG OF WATER TRAVELING AROUND AN ELBOW AT HIGH VELOCITY

The velocity in condensate lines is invariably high at some point in the system. It is believed that the water is likely to separate out into slugs which may generate considerable surge pressure when traveling around elbows at high velocity. This will result in high unbalanced forces on the piping system, and in extreme cases might even rupture the pipe. For this reason, a theory is needed to enable a designer to control these forces, or at least to know where they exist. It is believed that by installing long radius bends in place of elbows at critical points in the system, the designer can greatly reduce these surge pressures.

The first step in the process is to calculate the velocity of the fluid through the elbow. $U = 144\, E\, M / (62.5 \times 3.6 \times A)$, or:

$$U = 0.641\, E\, M / A \quad \ldots\ldots [11]$$

By referring to Fig. 3, an approximate formula may be developed for calculating surge, as follows:

The radial acceleration of a slug of water going around the elbow may be written:

$$\text{Acceleration} = U^2 / R = U^2 / N\, D' \quad \ldots\ldots [12]$$

It is also necessary to figure the mass of the water in the differential length of pipe (dL).

$$\text{Mass} = 62.5\, \pi\, (D')^2\, dL / 4g \quad \ldots [13]$$

SYMBOLS

A = actual cross sectional area of pipe, sq in.
Ao = theoretical cross sectional area of orifice, sq in.
Av = area of vent on flash tank, sq in.
Af = cross sectional area of flash tank, sq in.
B = constant read from curves in Fig. 1, $B = \int_{P'}^{P} dP/V$
Bo = the same constant read from curves letting $P = Po$
B'' = the same constant read from curves letting $P = P''$
C = constant read from curves in Fig. 2, $C = 31.9 \log (V/Vi)$
Co = the same constant letting $P = Po$
C'' = the same constant letting $P = P''$
D = inside diameter of pipe, in.
D' = inside diameter of pipe, ft
Do = diameter of orifice, in.
dp' = differential pressure drop due to friction, psf
dp'' = differential pressure drop due to inertia, psf
dp = total differential pressure drop, psf
dP = total differential pressure drop, psi
dt = differential time for fluid to travel distance dL, sec
dL = differential length of pipe, ft
E = constant read from curves in Fig. 2, $E = V/Vi$
f = dimensionless friction factor ($f = 0.003$)
G = mass velocity, lb/sec ft^2, $G = U/V = 144\, M/3.6\, A$
g = acceleration given to a 1 lb mass by a 1 lb force = 32.2 ft/sec^2
H = lost head due to friction, ft
K = Williams and Hazen roughness coefficient
L = the equivalent length of the system measured from the inlet end up to the point where P is measured, ft
Lo = the equivalent length of the system measured from the inlet end up to the point where Po is measured, ft
L'' = the equivalent length of the system measured from the point where Po is measured and continuing on to the end of the system, ft
M = the mass flow through the system, thousands of lb per hr
N = the radius of the pipe bend expressed as number of pipe diameters
P = the pressure at any point in the system, psi absolute
Po = the pressure between the two parts of the system, namely the piping and the orifice. For example, if the orifice is at the inlet end of the system, Po would be the pressure at the outlet of the orifice, psi absolute
P'' = the critical pressure as read from the curves in Fig. 7, psi absolute
q = the volume flow of water assuming no flashing, gpm
R = the mean radius of the pipe bend or elbow, ft
R'' = the mean radius of the pipe bend or elbow, in.
S' = surge pressure, psf
S = surge pressure, psi
T = the total equivalent length of the entire system including pipe, fittings, and orifice ($T = Lo + L''$), ft
U = fluid velocity through the pipe ($U = dL/dt$), ft/sec
V = the specific volume of the steam water mixture in pipe, cu ft/lb
Vo = specific volume at point where Po is measured, cu ft/lb
X = L/T
Xo = Lo/T
Y = $(Pi - P)/(Pi - P'')$
Yo = $(Pi - Po)/(Pi - P'')$

Subscripts indicate conditions applying at specific points as follows:

e = At any elbow in the system
f = At the flash tank
i = Inlet of system
o = At the orifice.

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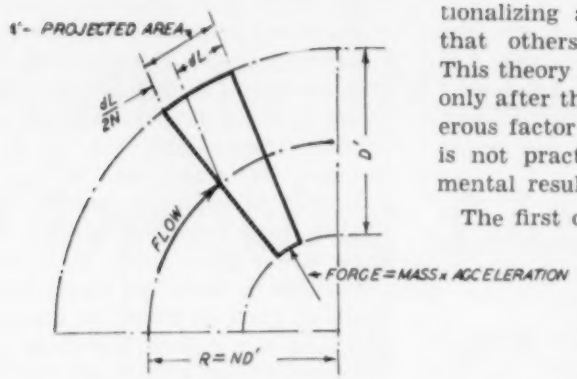

Inertia force acting on a slug of water travelling around an elbow at high velocity (This is Fig. 3 as referred to in Appendix C)

Force = Mass × Acceleration = $1.525\ U^2\ D'\ dL\ /\ N$. From this the surge may be calculated:

$$S' = \text{Force}\ /\ A''$$
$$= 1.525\ U^2\ D'\ dL\ /\ N\ A'' \quad \ldots[14]$$

where A'' = the projected area of the differential length dL (see Fig. 3).

The outer portion of the wedge shape section as shown in Fig. 3 is the area against which the above centrifugal forces are carried. The following expression is approximately true:

$$A'' = D'\ dL + D'\ dL/\ 3N$$
$$N\ A'' = D'\ dL\ (N + 0.33)$$

Substituting in equation [14], we obtain:

$$S' = 1.525\ U^2\ /\ (N + 0.33)$$
$$S = U^2\ /\ 94.5\ (N + 0.33) \quad \ldots\ldots[15]$$

It can be seen from the above equation that the surge pressure may be reduced by using long radius pipe bends. It would be very desirable to use laterals in place of tees whenever it is necessary to combine two streams. The piping must be anchored to withstand the total unbalanced force ($S\ A$).

APPENDIX D—DEVELOPMENT OF A FORMULA FOR CALCULATING THE FLOW OF A MIXTURE OF STEAM AND WATER THROUGH AN ORIFICE LOCATED AT THE OUTLET END OF A PIPE LINE

The problem of calculating the flow of a mixture of steam and water through an orifice located at the outlet end of a pipe line is very complicated. Worse than that, the author knows of no experimental evidence to support the theory which is about to be developed. Further, it is necessary to make two bold assumptions which may be seriously in error. This development is presented to assist in rationalizing any experimental data that others may have obtained. This theory is to be used for design only after the application of a generous factor of safety, and when it is not practical to obtain experimental results on which to design.

The first of the two assumptions that must be made is that thermodynamic equilibrium is maintained in the orifice. It has already been shown that this assumption would not apply for flow through an orifice located at the inlet end of a line. In that case, however, no flashing had occurred ahead of the orifice. In this case, flashing ahead of the orifice has already started, and it is thought probable that, having once started, it will continue flashing as it passes through the orifice. This assumption is made mainly for lack of a better one, and, in any event, the error will be on the safe side.

The second assumption that must be made is that the expansion through the orifice is at constant enthalpy. This assumption is made for practical reasons. An assumption of expansion at constant entropy would better describe conditions in the orifice itself; whereas the assumption of expansion at constant enthalpy better describes conditions in the pipe ahead of the orifice. It seemed impractical to change assumptions in midstream, so it was decided to use the constant enthalpy assumption all the way through. It is not believed that the error in this assumption is serious, and it is hoped that it will partially offset the error made in the first assumption.

In order properly to analyze this problem, it was decided to replace the pipe ahead of the orifice with an imaginary pipe having the same diameter as the orifice. This imaginary pipe would be made enough shorter so that it would have the same pressure drop as the pipe which it is replacing. The length of this imaginary pipe will be called (L'). The diameter of the imaginary pipe will, of course, be (Do). As far as the orifice is concerned, it does not matter how the fluid is delivered to the orifice so long as it is delivered at the same specific volume in the imaginary pipe that it would have in the real pipe. The following relationships will hold for the imaginary system:

$$T' = L' + L''$$

Equation [7] may be rewritten as follows:

$$[40.3\,Bo\,(Ao/M)^2] = (L'/Do) + Co \quad \ldots\ldots[7b]$$
$$[40.3\,B''\,(Ao/M)^2] = (T'/Do) + C' \quad \ldots\ldots[7c]$$

In this problem, the orifice is treated as a piece of pipe having zero length; so $L'' = 0$ and $T' = L'$ which may be substituted in [7c]. Subtract equation [7b] from [7c] to obtain:

$$[40.3\ (B'' - Bo)\ (Ao/M)^2] = (C'' - Co)$$

Transposing:

$$Ao^2 = M^2\ (C'' - Co)\ /\ (B'' - Bo)\ (40.3) \quad \ldots\ldots[16]$$

APPENDIX E—SUGGESTIONS FOR DESIGNING FLASH TANKS

It is recommended that flash tanks be installed vertically with tangential inlets to assist in the separation of the water and steam. It is also recommended that the vent be designed for a maximum of 100 fps velocity. Let:

Av = the area of the vent pipe, sq in.

M = the total maximum flow of all lines connecting to the flash tank, thousands of lb per hr.

U = 100 fps.

$E = Vf/Vi$. This constant is read from the curves in Fig. 2. In reading the curves, let P equal the actual pressure in the flash tank. Although it is impossible to obtain a pressure at the outlet end of the pipe less than the critical pressure, nevertheless the pressure in the tank itself can, and usually will, be lower. We can now solve equation [11] to obtain $U = 100 = 0.641\ E\ M\ /Av$. Solving, we obtain:

$$Av = 0.00641\ E\ M \quad \ldots\ldots[17]$$

It is recommended that the upward velocity of steam in the flash tank be kept below about 3 fps to reduce entrainment of condensate in the escaping steam. Let Af = cross sectional area of the flash tank. From equation [11]:

$$U = 3 = 0.641\ M\ E\ /\ Af$$
$$Af = 0.214\ E\ M \quad \ldots\ldots[18]$$

DATA SHEET

These Safety Rules Reduce On-the-Job Piping Injuries

SAFETY FIRST is a slogan that's known better than it's observed. On-the-job injuries in the pipe trades can be classified as due to unsafe acts and to unsafe conditions. This excerpt from a course in pipe fitting and plumbing prepared by Dr. Oliver S. Walsh for the bureau of trade and industrial education of California's state department of education points out that the proper way to do a job is the safe way, that accidents are evidences of inefficiency

ON-THE-JOB injuries in the pipe trades can be classified by their two main causes: (1) unsafe acts, for which the worker himself is directly responsible, and which constitute the major cause of industrial accidents; and (2) unsafe conditions in the area of work. Reading about these precautions may seem repetitious, as being merely a re-statement of common "horse" sense that everybody has. It is proved every day, however, that many injuries are caused simply by the failure to use this horse sense. Safety and efficiency are tied together. The proper way to do a job is the safe way. Haphazard acts and accidents are evidences of inefficiency.

Some of the specific causes of accidents, classified on the basis of environmental factors and human factors (which are, in reality, inseparable), are as follows:

Mechanical or Physical Hazards (Environmental)

1) Unguarded or insufficiently guarded machinery and structures.
2) Defective, inadequate, or improper facilities.
3) Slippery, uneven, or cluttered workplaces.
4) Hazardous arrangement or support of facilities or materials.
5) Moving, falling, or flying objects.
6) Dust, fumes, gases, vapors, and other harmful substances.
7) Insufficient light or ventilation.
8) Improper clothing and protective devices.

Unsafe Behavior (Human)

1) Failure to follow instructions, heed warnings, or use safeguards.
2) Insufficient training or instruction and unawareness of danger.
3) Shortcuts, undue haste, and other improper work habits.
4) Improper teamwork or failure to coordinate operations.
5) Lack of consideration for others, including horseplay.
6) Improper posture and attire.
7) Improper use of facilities or failure to use proper facilities.
8) Worry, distraction, intemperance, fatigue, and physical impairment.
9) Improper work habits, such as those that may occur when lifting, carrying, and so forth.
10) Failure to anticipate dangers and take precautions to avoid them.

Lifting and Carrying Hazards

Unsafe lifting practices lead to serious injuries, such as strains, sprains, and hernias. Surveys indicate that 25 to 30 percent of all industrial accidents result, either directly or indirectly, from improper lifting or carrying of objects. The average period of disability resulting from lifting injuries varies from seven to 19 weeks, with hernia injuries averaging from eight to nine weeks. Weight lifting and carrying, coupled with unsafe working conditions—such as wet or oily floors, pipe or other types of obstructions in walkways or on stairs or scaffolds—may produce even more severe disabilities, such as bone dislocations and fractures.

The principal causes of strain from lifting may be summarized as follows: (1) lifting by persons not physically capable of handling the job; (2) overtaxing physically fit workers by failure to set a limit on objects lifted or to control the pace or duration of the work; (3) uncoordinated lifting by two or more workers, resulting in too much burden being placed on one man; (4) lifting incorrectly, which results in undue strain on certain muscles and ligaments; and (5) lack of neatness, which results in disorderly arrangement, causing tripping and slipping hazards.

There are many satisfactory ways of carrying loads, such as the shoulder method, the nape-of-the-neck method, the side carry, and the team carrying method. But workers using each of these ways, to be safe, should follow three simple rules: (1) the load should be carried close to the body and as near as possible to the carrier's center of balance so as to prevent his becoming off balance while walking; (2) there should be unblocked vision ahead, with nothing projecting above the face of the carrier; and (3) the load should interfere as little as possible with the carrier's normal walking gait.

When it is necessary to lift heavy pipe or other units from the floor, the lifter should always keep his feet close enough together so as to provide good leverage, but not so close as to get off balance. In order

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to minimize the strain on the back and stomach muscles, knees should be used as a fulcrum when lifting.

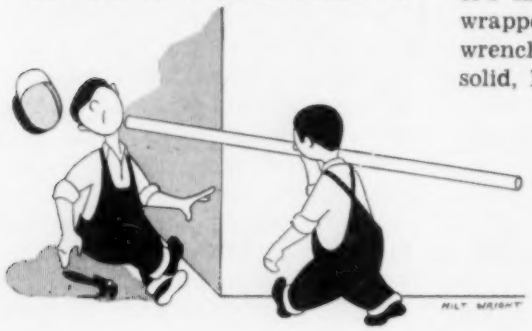
The pipe carrier should be sure that he is not overtaxing his strength, simply because the object he is carrying looks easy to handle; and he should never carry several loose pieces at once, because they might fall and act as skids and rollers to himself and others. When the carrier conveys a long piece of pipe, he should take care, when nearing a corner or doorway, that the front end is always raised well above the height of a man. For, then, if someone is met as he goes around a corner or turns into a doorway, the pipe will not strike the head of a person approaching unseen. Likewise, when on scaffolds or other unsafe places, the pipe carrier should not swing long pieces of pipe around carelessly, for they may hit another worker.

Hanging Pipe

When heavy pipe is hung permanently, the worker should be sure it holds his weight; this precaution will protect someone else, who may be careless and try to support himself on the pipe by using it as a scaffold or ladder. The tradesman should never use string or light cord to make temporary pipe hangers, nor should he put up flimsy pipe supports of any kind. To prevent a line from being knocked out of place before permanent hangers are installed, he should use heavy pieces of wood and strong wire that are securely fastened.

Workers should take extra care when handling pipe that has been heated for bending, welding, or steam testing. They should be sure that their hands are protected and that they do not take hold of the heated end. Pipe, lifted by the flanged end after welding, should be properly cooled or protected first otherwise severe burns may result.

The feet of a ladder should be placed at a distance away from the wall (against which the ladder is leaning) that is equal to one-fourth of the length of the ladder. A weak or broken ladder with missing rungs should never be used. The tradesman should always face the ladder when ascending or descending. Loose tools should never be left on top of a stepladder or scaffold.



Any scaffold plank that shows the slightest sign of weakness should be either discarded or marked so that it will not be used. Any temporary staging or platform should be constructed safely enough to hold the weight of the worker, or workers, as well as the maximum load of materials expected to be used on it. Also, it is important that a tradesman inform his fellow workers about what he plans to do—misunderstandings often lead to injuries.

Tools and Equipment

All tools and equipment, as well as materials, should be kept in their proper places, or piled up properly when not in use. They should never be left in walkways, on stagings, on stairs, or on the tops of studs, rafters, ladders, and cornices, where they may work loose and fall on someone below. Defective tools or equipment, which have been damaged, broken, or dulled, should never be used until put in good shape. Sharp pointed tools, such as screwdrivers, chisels, files, punches, and saws, should not be carried about carelessly or put in the worker's pockets. When sharp-edged tools are not in use, suitable shields should cover them. Hammer handles should be tested by the worker to see that they are on safely, and all handled tools should be investigated for splinters.

Before using a wrench, the worker should adjust it properly so as to prevent the head from slipping; a wrench with worn teeth or open jaws should not be used. The worker's fingers should not be tightly wrapped around the handle of a wrench when working alongside a solid, heavy object, because if the wrench slips, his fingers are likely to be smashed against this object. The palm of the hand should be used and the fingers kept free. The proper size of wrench should be used at all times.

Pipe tradesmen are constantly called upon to get into excavations to install various kinds of water, sewer, gas, and heating lines. For trenches in hard, compact ground, the use of vertical braces, located every 8 ft, and horizontal stringers, placed every 4 ft, that are held in place by screw jacks or timber braces, is usually sufficient; but in soft ground or wet ditches, complete shoring, backed by sheet piling, is necessary to prevent cave-ins.

Industrial Poisons and Personal Precautions

The poisonous character of many substances used in modern industry may constitute a serious health hazard to workers. Some of these substances irritate the skin and membranes, others are inhaled and congest the lungs, and still some others are absorbed by the body as a whole over long periods of time.

Poisonous types of industrial irritations may be guarded against by using protective ointments, gloves, respirators, and goggles; by taking a bath once a day after work; by having periodical medical examinations; and by wearing special clothes while at work, and then changing into clean clothes before going home. In cases where workers are in contact with substances such as lead fumes or dust, which enter the body through breathing or eating or wetting the lips, the following are among the recommended safety practices; eat meals outside the workroom; drink plenty of milk; keep dirty fingers away from the face or mouth; wash thoroughly the hands, lips, and mouth before eating.

Additional personal precautions that tradesmen should take to guard against illness or injury are as follows: (1) Wear proper working clothes; ragged, dirty, loose, and flapping clothes are not only unsightly but are dangerous; shoes should have heavy soles and not have long, loose laces; rolled up or torn cuffs on overalls are likely to cause falls; worn pockets may allow tools to fall through and injure workers below; (2) wear goggles if working near concrete or metal chipping or any type of grinding operation; and (3) have cuts and abrasions properly attended to immediately.

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Train Ride Reminder of Wonders of Glass

Inspired by a pleasant afternoon ride in the "Vista-Dome" of a modern railroad car, Mr. Lewis devotes his "page" this month to some of the wonders of that curious substance, glass, and to its uses in heating, piping, and air conditioning in industry and building

I HAD A pleasant afternoon ride not long ago on the Twin Cities "Zephyr," in a "Vista-Dome." In this modern, glass roofed car, the passenger may have a delightfully comfortable seat up under the dome, near the easiest riding, center part of the stainless steel car. He can see all around and will realize, as I did, how different and more attractive the long familiar old roadside vistas in city or village or countryside will appear.

The passenger in an ordinary car can see things on one side only, or if there is a rear end observation car, he may gain a fleeting view of things long past.

In the dome, however, the eye level is high enough to take in the world, and the passenger may see far ahead, even as does the engineer, and obtains a comprehensive appreciation of scenery without being too close to it to see it flash by and without (as in an airplane) being too far away to see much of anything. The speed of the train seems not nearly as fast from the "Vista-Dome" as it seems from the conventional side window.

Air conditioning the dome was not too easy, since the area of the unglazed part of the roof is cut to a minimum, but filtered and acceptably heated or refrigerated air is introduced through metal plates having hundreds of tiny circular orifices in this small ceiling.

To reach the ceiling of the dome, however, with ducts, and without blocking off some of the safety glass area, required ingenuity to which I must bow. They simply made the up-coming duct out of glass! To anyone not in on the secret, the air supply seems to generate itself spontaneously in the ceiling of the dome.

This Curious Substance

So, I commenced to remember some of our obligations to this curious substance, glass. It is resistant to the corrosive effect of gases and liquids that can destroy almost any other surface or container. This compound of opaque silica sand and several alkaline substances, also opaque, can become transparent and invisible, or can be tinted to almost any shade or color that may be desired.

When heated to the proper temperature, glass becomes pliable and may be cast like molten metal or may be bent and fabricated like wrought iron. Glass is cast into sheets as for plate windows or into blocks for walls of buildings. Beautiful ornaments are made from heat-softened tinted glass.

I have employed it as walls to enclose chemically resistant research laboratory rooms. I used it (and I thought I was a pioneer in so doing) for ducts to deliver con-

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ditioned air in buildings of the Century of Progress, in 1933.

Glass applied to the inside of an enormous hot water tank in a laundry ended forever the stains from rust. Glass lined piping—and piping of glass—are available and serve many purposes, and we have used pumps made of glass for handling special liquids. Glass, spun in nearly invisible threads, has made my non-wrinkling, long wearing, and rather beautiful necktie. These same silica fibers—somewhat coarser and matted into pads and lightly coated with adhesive—make an excellent air filter. When dry, the same matted fibers, placed around very hot boilers and pipes, resist passage of heat about as well as does any known insulation, yet suffer no harm from the high temperature and refuse to ignite at any temperature.

Glass fibers are used widely in industry and commerce for reducing heat transfer through walls, roofs, and floors. We also employ them in the form of blankets above hot water pipes imbedded in plaster for radiant heating of rooms.

Ceilings of swimming pools below cold roofs—and the roof structure above them—are effectively protected against deterioration from condensed moisture by water-resistant glass fiber insulation.

Molten glass expanded by internal gases forms a mass of tiny, nonconducting bubbles, resulting in a heat barrier which is entirely inorganic.

Without glass, many of the best electric motors and generators and batteries and switches would lose their standing in the community, and of course glass insulators for outdoor electric conductors are useful not only to conserve the electric energy but also to serve as targets for itinerant riflemen.

Glass as a Building Material

Frank Lloyd Wright and the Johnson Wax Co. used glass tubes laid horizontally—like logs in a pioneer cabin — for windows, thus achieving a double barrier with a quiet air space between. Our forefathers were compelled to replace occasionally the chinking between logs, as probably is the case with the sealing compound between these glass tubes.

Hollow blocks of glass built into building walls have decided advantages in beauty and in resistance to heat flow, though it is important that when large single areas of glass blocks are used, the surrounding opaque structure shall have a rate of expansion and contraction similar to that of glass in reaction to temperature changes. Failure so to do may result in broken glass blocks, leakage through joints, and in development of cracks in the material surrounding the glass.

Of topmost importance is the fact that I couldn't possibly see to write this, or to read the Bible, or to find your number in the telephone directory, without glass!

In the dome, the eye level is high enough to take in the world

NARC DECIDES ON NAME CHANGE

At a recent meeting, the board of directors of the National Association of Refrigeration Contractors decided to recommend to the membership that the name of the association be changed.

It is felt that the present name does not adequately cover the industry as served by its members, some of whom sell, construct, install, and service both refrigeration and air conditioning equipment, while others specialize in either refrigeration or air conditioning.

The name to be suggested to the membership will be the Refrigeration & Air Conditioning Contractors Association.

'48 REAL WEALTH TWICE THAT OF '24

The American people created for themselves last year nearly twice as much in real wealth as they did 25 years ago, Crawford H. Greenewalt, president of the Du Pont company, said last month.

In terms of purchasing power, the only "significant coin," the industrial employee today needs to work, on the average, a little over half as long as in 1924 to buy the same amount of goods, he pointed out in a talk to Du Pont employees and business leaders in Buffalo, N. Y., marking the 25th anniversary of cellophane.

The nation's "stockpile of productive tools," which produces this real wealth, has been built by the readiness of the people to save, and invest in the nation's enterprises, Mr. Greenewalt declared.

"We have made our progress only because we have been willing, individually and collectively, to invest more and more money in providing these tools of production. Since 1924 the investment in American industry has nearly doubled.

"But back of that willingness to save, to invest, to risk those savings in industrial ventures is the hope of profit," he warned. "Remove that profit motive and we destroy all hope of future prosperity."

Mr. Greenewalt cited the cellophane industry as representative of American business enterprise in the past 25 years, the era in which the real wealth of the nation and the investment in industry has nearly doubled.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Here's How to Service Air Conditioning Jobs

Information on the management and operation of service departments in the air conditioning field was requested by "J.C." in his question published in the March HPAC, as he is taking over this type of work for a contractor and needs advice on methods, personnel, etc. A most comprehensive and helpful reply to his question is published here

PERFORMING air conditioning service on a large scale over a 24 hr a day period can be an extremely costly procedure unless adequate control of inventory and disposition of the mechanics are exercised.

Materials must be kept in stock for service required when supply houses are closed, yet the space and money required would be disproportionate to the volume of business if a careful control were not kept to assure that no parts are lacking when required, that a minimum amount of rarely used parts is stocked, that supplies requiring lengthy delivery are ordered sufficiently in advance, and that a careful record of the inventory is available to the purchasing department.

A service organization must be just what the name implies. It must give service to the customer, and it must be an efficient organization unto itself—or the service manager will soon be replaced by the sheriff. If fair rates are charged and inefficiency prevails, a loss will be incurred. If the customers are charged for its shortcomings, they will very shortly call another service organization to do their work.

After 15 years of engineering, installing, and servicing commercial, industrial, and residential air conditioning equipment along the entire Atlantic seaboard from Maine to Florida, (as well as the hinterlands), we have come to the conclusion that in that entire area there is no section where the service problem is as great as in the South Florida area because of the climate, usage of equipment, and operating conditions. If our contention is correct, conditions of inefficiency that are minor in other sections are greatly magnified here and can mean the difference between large losses or fair profits.

Although only service organizations in our particular locality would be interested in all of our service procedures, we believe that we have all of the service problems that may only be partly encountered in other parts of the country. The only exception would be protection against freeze-ups, and we will endeavor to touch on that problem later.

Water, Long Operation Are Problems

The semi-tropical climate that brings so many tourists and vacationers to South Florida annually presents a corrosion problem similar to that experienced by the Army and Navy on the Pacific islands during the war.

Water available for condensing purposes is extremely hard, coating condensers and pipe with calcium

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AGREEMENT

Stuart hereby agrees to furnish and Purchaser hereby agrees to pay for inspection, maintenance, rust retarding, and service subject to the following conditions, for the equipment only, located at the aforementioned premises.

The equipment covered by this agreement includes the following compressors and mechanical systems of which they are a part. Ductwork, plumbing, wiring, insulation, or any other work that is not an integral part of the refrigeration cycle is not included.

Stuart agrees to make..... inspections each year, and at time of inspection, to perform the normal services listed below:

1. Inspect equipment for refrigerant leaks.
2. Repair all leaks in refrigerant mains.
3. Clean commutators on motors.
4. Clean all motor housings.
5. Clean condenser annually on water-cooled systems.
6. Clean lint and dirt from air-cooled condensers.
7. Clean condensing units.
8. Clean all strainers.
9. Adjust tension on all belts.
10. Lubricate all moving parts.
11. Check operating pressures of condensing units.
12. Purge air from systems.
13. Check refrigerant in systems.
14. Charge refrigerant into systems as necessary.
15. Inspect and adjust temperature controls.
16. Inspect and adjust safety controls.
17. Inspect and adjust all valves.
18. Adjust water regulating valves.
19. Check operation of refrigerant controls.
20. Supply emergency service between regular inspections.

And on air conditioning systems to:

1. Clean steam traps or electric heaters.
2. Check and adjust dampers and air distribution.
3. Change over and set controls for seasonal operation.
4. Inspect air filters.
5. Clean evaporative condensers or cooling towers.
6. Clean drip pans.

Rust Retarding:

1. Examine all parts at intervals not exceeding 6 months.
2. Where rust is found, chip, scrape, and wire brush same until bare dry shiny metal is discernible.
3. If this surface is not in constant contact with water, apply zinc chromate or red lead.
4. If this surface is in contact with water, apply heavy coating of bitumastic paint or hot pitch.
5. After application, 3 or 4, as required, paint entire surface with aluminum paint.

It is assumed that, at the time that this agreement is entered into, all machinery is in proper operating condition. However, the following equipment is not in proper condition for reasons mentioned below, and any service necessitated by these items shall be charged for at our regular billing rates until such time as these deficiencies are corrected.

Stuart agrees to furnish the following materials as and when necessary:

1. Necessary lubricant (oil or grease) for fan and motor bearings.
2. Necessary fuses.

It is mutually agreed:

1. That Stuart shall not be required to furnish replacement parts, refrigerant and supplies other than those listed above, or to repair damage to the equipment due to causes beyond our control. Additional materials will be furnished by us at our regular selling prices, less 10 percent.
2. All work to be performed during Stuart's regular working hours of regular working days. If, for any reason, Purchaser requests that examinations or adjustments be made on overtime, Purchaser agrees to pay the difference between regular and overtime labor at regular billing rates.
3. Any additions, alterations, adjustments or repairs made by others, unless authorized by Stuart, shall terminate Stuart's obligations hereunder. Stuart is not obligated to assume the charges or to make a refund to the Purchaser for any service work performed, or for any material furnished by persons other than Stuart.
4. Any repairs, refrigerant and supplies other than those listed above deemed necessary and recommended by Stuart for efficient operation of Purchaser's installations are to be authorized by Purchaser. Unless these recommendations are accepted by Purchaser and authorization given to perform this service, Stuart will not furnish emergency service. The Purchaser shall accept the judgment of Stuart as final as to the means and methods to be employed for any corrective work.
5. In the event Stuart is required to make emergency calls occasioned by the improper operation of the equipment or due to damage caused by floods, lightning, fire, elements, rebellion, riots, strikes, labor troubles, civil commotion of any kind, or due to Purchaser's failure to follow Stuart's recommendations as noted in Item 4, or for any causes beyond Stuart's control, Purchaser shall reimburse Stuart for the expense incurred in making the emergency call in question, in accordance with the current established rates for performing such service.
6. Stuart shall not be liable for the operation of the equipment nor for injuries to persons or damages to property, except those directly due to the negligent actions or omissions of Stuart's employees. Stuart shall not be held liable for any loss or damage due to delay in furnishing labor or material for any cause beyond Stuart's reasonable control, and in any event Stuart shall not be liable for any consequential damage.
7. The amount of any past or future sales, use, service, excise or other similar tax, Federal, State or Municipal which Stuart shall now, or hereafter be liable for, or required to pay, either on Stuart's or Purchaser's behalf or otherwise, with respect to Stuart's obligation to furnish services and supplies hereunder, shall be in addition to the sum payable by Purchaser under this proposal and shall be paid by Purchaser upon the rendition of separate invoices covering such tax.
8. Any violation on the part of the purchaser of any of the terms of this agreement, or non-payment of bills, rendered in relation to this agreement within 30 days of invoicing, shall be sufficient cause for Stuart to be relieved of their responsibility under this agreement and to cancel same without notice. In case suit shall be brought for collection of bills in relation to this agreement or same has to be collected upon demand of an attorney, purchaser agrees to pay reasonable attorney's fee for making such collection.

Stuart's inspection, maintenance, service, and rust retarding shall be furnished:

From: To:

for the sum of:

payable in advance as follows:

This agreement shall remain in effect for one year from date of signing and shall continue from year to year thereafter, at an increase of 10 per cent each year, unless thirty (30) days prior to the termination of any yearly period, either party gives written notice to the other of their intention to terminate same.

This agreement is signed in duplicate this..... day of..... and constitutes the entire contract between us. All prior representations or agreements not incorporated herein are superseded.

Accepted by:

STUART COOLING CORP. OF FLORIDA

By:.....

The service agreement for any particular locality should of course be framed in accordance with the laws of that state or area

carbonate and sending condensing pressures to 175 lb within six months if not properly maintained.

Regulations prohibiting disposal of condenser water into municipal sewage systems require that cooling towers or evaporative condensers be used even on 3 and 5 ton self-contained units.

The design wet bulb temperature is 79 F, causing higher condensing pressures than those considered standard throughout most of the rest of the country.

Our greatest industry is tourist travel—people on vacation who don't go to work the following morning. As a result, many restaurants are open all night, and hotels run their air conditioning systems 24 hr per day. Because of the high temperatures prevailing the year 'round, the air conditioning systems must operate a minimum of 10 to 11 months a year. Certain establishments, where the main heat source is internal (lights and people), have actually operated 24 hr a day 365 days a year.

It thus can be realized that because of longer hours of operation at higher pressures than normal, with extra equipment such as evaporative condensers or cooling towers on practically every job, coupled with the rust problem, the hard water situation, and the occasional damage due to hurricanes, there is no area in this entire country where so much air conditioning service is required, and where attention must be paid to so many details of operation.

Methods of Servicing Customers

Several methods are used to maintain rapid and efficient service at nominal cost to the customer.

First, a customer may take service on a per call basis, or may use one of our three maintenance or service contract plans. These plans have advantages to both the user and the service company.

The advantages to the customer include reduced service costs, averting breakdowns before they occur, and keeping the equipment at peak efficiency. To the contractor, the advantages include scheduling men in advance, affording mechanics steady work, accurately forecasting volume, reducing overtime requirements, and greater profits.

Our first contract service plan is monthly maintenance only. Our second is monthly maintenance plus emergency service, and our third plan is the same as the second with the addition of rust retarding.

Our service contract agreement is reproduced here. However, such a contract form for any particular locality should of course be framed in accordance with the laws of that state or area.

Mechanic Takes Check List

When a mechanic is dispatched from the office for a monthly maintenance check, he takes the monthly maintenance check list reproduced here with him. He goes through the 48 steps listed thereon, taking care of those items that apply to the particular installation. As an illustration, let's run through the list, discussing the matters in the manner that the service man would operate.

No. 1: Lubricate motor bearings. The compressor motor is lubricated with oil or grease as required.

No. 2: The compressor oil level is checked in a sight glass and refrigerant oil is added if required.

Nos. 3-4-5: All systems above 10 hp are equipped with permanent gages. The mechanic reads and records the head pressure, suction pressure, and oil pressure. Should any of these be other than normal, proper steps are taken to correct the condition.

No. 6: The system is pumped down to ascertain that the low pressurestat will shut the system off at the proper pressure. The compressor is also operated without the condenser to ascertain that the high pressure cutout stops the compressor at the proper temperature.

No. 7: The compressor bolts are checked and tightened at six month intervals unless some very evident indication is seen that it is required between these six month inspections.

No. 8: Refrigerant is checked in the sight glass, and if required, additional refrigerant is added.

No. 9: Test for leaks. The average job leak test is made at the seal, at flare connections, and any other point of known leakiness. At each inspection an entire recheck is made whenever there is any indication of refrigerant lost.

No. 10 is self-explanatory.

No. 11: Compressor belts are checked for proper tension and alignment.

Nos. 12-13-14: Pump and fan motor, evaporative condenser, and cooling tower are properly lubricated, as well as the pump and fan.

No. 15: At six month intervals the

WHAT'S BEST WAY TO EVAPORATE THIS EXCESS WATER IN INDUSTRIAL PROCESS?

***YOU ARE INVITED** to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed, and—space permitting—will be published. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.*

"The final operation in the manufacture of cold synthetic rubber is putting a talc powder on the surface to facilitate handling and prevent the surface from becoming tacky.

"Dusting creates an occupational hazard, so the bales of rubber (7 in. x 14 in. x 28 in.) are dipped in a slurry of talc and water. After leaving this solution, they pass along a roller conveyor to the point where they are packaged. The speed of this conveyor is such that three bales pass a given point each minute.

"Each bale picks up approximately ½ lb of water in the dipping operation, which must be evaporated before packaging, leaving only the talc. This evaporation must take place from each bale within 1½ min, and temperatures higher than 140 F cannot be used due to expansion of the bales. Refrigeration or chemical dehumidifiers cannot be used due to the cost. There is 15 psi steam and three phase power available. Ambient conditions vary from 95 F DB and 80 F WB in the summer to 20 F DB in the winter.

"How would you evaporate this water?"—F.R.Y.

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condensing coil is checked for chemical deposits, scale, or dirt, and if found, they are removed.

No. 16: Water spray nozzles are checked at each coil to make sure they are not clogged in any manner, and if they are found clogged they are cleaned.

Nos. 17-18-19: The strainer screens for the city water make-up, the pump intake, and the outside air intake are checked, and cleaned if required.

No. 20: The make-up float control is checked to ascertain that a proper water level is maintained, and reset if incorrect.

No. 21: All water connections to the unit are checked for leaks.

Nos. 22-24: Condenser belts are checked, and are aligned and tightened if required.

No. 23: Rotation of fan is checked upon the first call, or any specific call after the electric changes have taken place in the building.

No. 25: The entire unit is examined minutely for rust, and a report submitted that is later followed up by another mechanic whose sole duties are rust retarding.

Nos. 26-27: The mechanic checks the condition of the water softener container and adds the required amount of water softener. This retards rust and chemical deposits as well as the growth of algae and fungi in the sump.

No. 28: Water regulating valve is adjusted, if required.

No. 29: At 90 day intervals the air cooled condenser is thoroughly cleaned.

Nos. 30-31: The fan and fan motor bearings of the air unit are properly lubricated. Belt condition, tension, and alignment are checked, and corrected if required.

No. 33: Replaceable type filters are changed and renewable filters are cleaned.

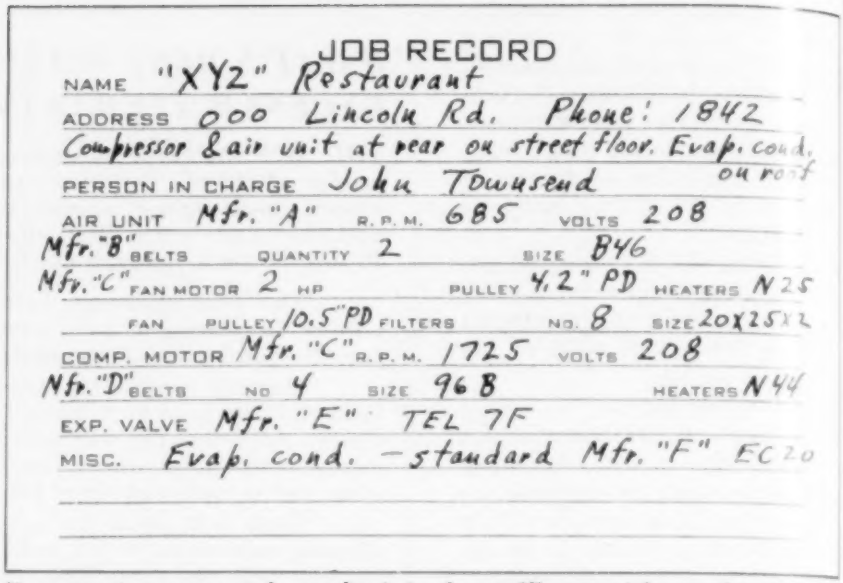
No. 34: Blower wheel fan alignment is checked, and corrected if required.

No. 35: Refrigerant strainer is checked, and cleaned if required.

No. 36: All water connections are checked for leaks.

No. 37: A complete report on rust is submitted together with the report aforementioned in Item 25, and attended to at the same time.

Nos. 38-39-40: Thermostat, starter, damper motors, and other electrical installations are checked for proper operation, and corrected if required.



JOB RECORD

NAME "XYZ" Restaurant

ADDRESS 000 Lincoln Rd. Phone: 1842

Compressor & air unit at rear on street floor. Evap. cond. on roof

PERSON IN CHARGE John Townsend

AIR UNIT Mfr. "A" R. P. M. 685 VOLTS 208

Mfr. "B" BELTS QUANTITY 2 SIZE B46

Mfr. "C" FAN MOTOR 2 HP PULLEY 4.2" PD HEATERS N25

FAN PULLEY 10.5" PD FILTERS NO. 8 SIZE 20X25X2

COMP. MOTOR Mfr. "C" R. P. M. 1725 VOLTS 208

Mfr. "D" BELTS NO 4 SIZE 96 B HEATERS N44

EXP. VALVE Mfr. "E" TEL 7F

MISC. Evap. cond. - standard Mfr. "F" EC 20

Upon starting a system, the mechanic in charge fills out a job record card so that the shop has a record of all parts that might be required to keep the system functioning properly

No. 41: Damper settings are marked on the ducts and the mechanic checks to see that settings have not been altered or quadrants loosened, and resets dampers when required.

Nos. 42-43: On the few well water jobs, the pump and pump motor are lubricated and air is purged by means of a petcock.

No. 44: The manager is instructed in the operation of the installation on the first call after a change of management.

No. 45: If any changes are made to the system, such as resetting controls or dampers or any precautions to be taken until the mechanic should call back, the manager is completely informed.

No. 46: In the event that the decalcomanias placed on the door advertising air conditioning within the premises should have deteriorated, these are scraped from the window and replaced.

No. 47: All parts of the system are wiped clean with rags.

No. 48: The mechanic gets a work order ticket from the customer as a receipt that the work has been accomplished and returns this maintenance check together with the work order, both signed by the mechanic, together with any additional remarks and advice the mechanic may make regarding the system. Work order tickets are padded in book form convenient for the mechanic to handle. These are in numerical order in duplicate, the original being retained by the customer and the duplicate being returned to the service manager. Both are signed by the customer and the mechanic showing the time spent on the job and the materials used.

Rust Retarding a Regular Service

Due to the combination of hard water, salt laden air, and high relative humidity found locally, one of the major problems has been with the rusting of equipment. This cannot be stopped entirely but the life of the metal can be prolonged by proper maintenance:

1) Examine all parts at intervals not exceeding six months.

2) Where rust is found, chip, scrape, and wire brush until bare, shiny metal is discernible.

3) If this surface is not in constant contact with water, apply zinc chromate or red lead.

4) If this surface is in contact with water, apply heavy coating of bitumastic paint or hot pitch.

5) After application (3) or (4), as required, paint entire surface with aluminum paint.

All applications to be made on dry surfaces.

Secure Equipment for Hurricanes

When monthly inspection is made, emergency calls are answered during normal working hours at no charge. When overtime is encountered, customers pay the difference between normal and overtime. The

customer pays for all materials except lubricants at all times. In the event of damage by hurricane, fire, strikes, acts of God, or any other causes beyond our control, the customer pays for all labor and all materials required to correct the damage. At no additional charge, immediately before hurricanes, mechanics are dispatched to each installation where equipment is located out-of-doors, to make sure that all hurricane bracing, guy wires, and panels are properly fixed and tightened in order to minimize hurricane damage.

Spring and Fall Operations

In those areas where cooling is not required during the winter, certain precautions must be taken in the spring and fall.

In the fall, drain all water lines, condensers, cooling towers, or vessels containing water. Where water is trapped, add sufficient antifreeze.

Pump down all refrigerant into receiver and close valves.

Check and adjust heating operation when same is part of air conditioning system.

If no heating is included, securely close outdoor air openings to prevent drafts, and remove all fuses so that equipment cannot be operated.

In spring, refill all water vessels.

Perform all applicable items on check list.

Close heating system.

Replace fuses if removed. Adjust outdoor air openings, if closed.

Drop back after 8 hr operation for observation.

Job Record Card

Upon starting a system, the mechanic in charge fills out the job record card which is shown herewith so that the shop has a record of all parts that might be required to keep this system functioning properly.

From this job record card, we immediately stock spare belts and other items that need frequent replacing so that if a night club, restaurant, or hotel that operates into the early hours of the morning needs immediate service (for example, saying that a belt has broken) the night service manager consults the job record card and calls the mechanic at his home telling him what size belt is required. If the mechanic does not have the belt in his car stock, he stops by the office on the way to the job and the belt is ready and waiting for him.

Service Card Posted on Job

A service card is posted on the job and is filled out by the mechanic at each visit so that any new mechanic visiting the job can consult the card to get an idea of where and when and what sort of trouble has been encountered on this job in the past. This reduces lost time in diagnosing trouble.

Emergency service is supplied 24 hr a day, seven days a week. An adequate stock of spare parts is maintained to meet all probable conditions. Mechanics report by telephone to the office at the completion of each call, immediately before lunch, before quitting for the day, and before any overtime is done, so that at all times the office is familiar with the state of conditions in the field, and the whereabouts of each mechanic, enabling the service manager greatest flexibility in taking calls and dispatching them among the various service men.

Bills Prepared From Work Order Ticket

Before leaving the job, the mechanic gets the work order ticket signed in duplicate (as mentioned before), leaving the original with the customer and returning the duplicate to the service manager. The service manager then checks this ticket against the dispatch sheet, forwards it to the stockman who records inventory changes, and he, in turn, forwards it to the accounting department.

Bills are prepared directly from

When a mechanic is dispatched for a monthly maintenance check, he takes this check list with him

MONTHLY MAINTENANCE CHECK LIST

JOB: "XYZ" Restaurant DATE: 12/6/48

COMPRESSOR
1. Lubricate motor bearings ✓
2. Check oil level ✓
3. Check head pressure 115
4. Check suction pressure 34
5. Check oil pressure 56
6. Check pressurestat oper. ✓
7. Check head bolts X
8. Check refrigerant ✓
9. Test for leaks ✓
10. Check rotation ✓
11. Align & tighten belts ✓

EVAP. COND. ~~OR TOWER~~
12. Lubricate motor bearings ✓
13. Lubricate fan bearings ✓
14. Lubricate pump bearings ✓
15. Check coil (scale or dirt) ✓
16. Check spray nozzles ✓
17. Check water strainer (make-up) ✓
18. Check pump strainer None
19. Check air intake screen ✓
20. Check float control ✓
21. Check drip pan & drain conn. ✓
22. Check drive belts ✓
23. Check rotation of fan ✓
24. Align & tighten belts ✓
25. Rust (casing & pan) report ✓
26. Water softener container ✓
27. Water softener added 2 lb

CONDENSER (Water Cooled)
28. Check water reg. valve None

CONDENSER (Air Cooled)
29. Clean condensing coil None

AIR UNIT
30. Lubricate motor bearings ✓
31. Lubricate fan bearings ✓
32. Check drive belts ✓
33. Check filters ✓
34. Check fan wheel alignment ✓
35. Check strainer ✓
36. Check drip pan & drain conn. ✓
37. Rust (casing & pan) report ✓

CONTROLS
38. Check thermostat operation ✓
39. Check starter operation ✓
40. Check damper motors None
41. Check damper settings ✓

WELL WATER JOBS
42. Lubricate pumps X
43. Purge air from lines

GENERAL
44. Instruct Manager in oper. ✓
45. Inform Manager of changes None
46. Check with Mgr. re decals O.K.
47. Wipe all dirty parts ✓
48. Get signed ticket for time & materials used ✓

MECHANIC, PLEASE NOTE: When completed, all items are to be checked, either with a ✓ to indicate work has been attended to, or an X to indicate item does not apply to this installation. This check sheet to be attached to signed service ticket and returned to Stuart at end of day.

STANDARD EQUIPMENT TO BE CARRIED BY MECHANIC: Mirror, gun and grease, flexible spout oil can, S.A.E. 30 oil, refrigerant oil, gages, leak detector, hand tools, rags, chalk, water softener.

MECHANIC'S REMARKS: Have you found evidence of rust? Yes
Have you circled and dated rust spots? Yes
Additional Remarks: Evap. condenser exterior rusted in several spots — interior O.K. — Air unit drain pan rusted near drain connection.
Use other side of sheet, if necessary, for further remarks.

Signed by: H. Palmer
Mechanic

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SERVICE CARD

FOR

NAME "XYZ" RESTAURANT

ADDRESS 000 Lincoln Road

FOR AUTHORIZED SERVICE CALL

STUART COOLING CORP. OF FLORIDA

1335 N. W. 21st ST. MIAMI 42, FLORIDA

9-3819

DATE	SERVICE RENDERED	MECHANIC
12/16/47	Started system in operation	HP
1/3/48	Rechecked for leaks & insulated	HP
2-3-48	Monthly maintenance check	EHJ
3-2-48	Monthly maintenance check	EHJ
3-17-48	Repair leak - added 15# refrigerant	EHJ
4-2-48	Monthly maintenance check	EHJ
5-3-48	Monthly Maintenance check	CJ
5-5-48	RUST TREATMENT	ECW
6-4-48	Monthly Maintenance check	CJ
6-29-48	Replace fan belts	CJ
7/7/48	Monthly maintenance check	HP
8/6/48	Monthly maintenance check	HP
9/6/48	Monthly maintenance check	HP
10/5/48	Monthly maintenance check	HP
12/6/48	Monthly maintenance check	HP
12-8-48	RUST TREATMENT	ECW

RETURN THIS CARD TO OFFICE WHEN COMPLETE

JOB NO. 201 INVOICE NO. 500 Nº 2662

STUART COOLING CORP.

OF FLORIDA

1335 NORTHWEST 21st STREET

Miami 42, Florida

STUART Cooling

12/6 '48

SERVICE TO "XYZ" Restaurant

ADDRESS 000 Lincoln Rd.

BILL TO Same

SERVICE RENDERED Monthly maintenance check
Added refrigerant — oil. Repaired
flare fitting at head pressure gage

Material Used	Price	C.O.D.	Charge	No Charge
8 lb refrigerant			Total Material	
1 pt refrigerant oil			(2) Hrs. at Job	
6 - 20x25x2 filters			(1/2) Hrs. Travel	
2 lb water softener			(3) Miles	
			Total Charge	

Job Completed ☑ Job Incomplete ☐

H. Palmer
Serviceman's Signature

We are not responsible for parts other than those furnished and installed by STUART COOLING CORP. OF FLORIDA.

Guarantees on all parts are limited to the guarantees given by the manufacturer to STUART COOLING CORP. OF FLORIDA.

No Verbal Agreements Will Be Recognized

The above described service and installation of parts listed has been authorized and hereby acknowledged. Equipment now operating satisfactorily.

Customer's Signature "XYZ" Rest./AC

***Left*—A service card is posted on the job and is filled out by the mechanic at each visit for future information. This reduces lost time in diagnosing trouble**

***Right*—The work order ticket, which is signed by the mechanic and the customer, goes to the stockman, who records inventory changes, and to the accounting department**

the work order ticket and mailed to the customer. Normal service accounts are payable within 10 days and then put on a COD basis until the account is current. Service contracts are payable the 10th of the following month and then put on a COD basis until current.

Perpetual Inventory of Parts and Tools

The company maintains three vehicles operated by employees, and other mechanics furnish their own cars for which they are allowed 6c per mile plus any tolls encountered, parking fees when necessary, etc. Mechanics work on an hourly basis with time and one-half after 40 hr per week, or for work before 8:00 a.m. and after 5:00 p.m., Monday through Friday.

Perpetual inventory is maintained of parts and tools in the shop and in the mechanics' car stocks. Car stock consists of belts, fuses, filters, refrigerant, refrigerant oil, machine oil and grease, soft copper tubing, solder, sandcloth, and fittings.

As items are removed from car stock or inventory, they are recorded on the work order ticket and on an inventory sheet by the stockman. As parts are delivered to the shop from the supply houses, they are checked against the invoices by the stockman, and these additions to inventory are then recorded on the inventory sheet. This inventory sheet is submitted to the accounting department weekly so that the master inventory record is kept current.—ARMAND COWAN, president, Stuart Cooling Corp. of Florida, Miami.

CONSTRUCTION CONTRACTS DECLINE 9 PERCENT

F. W. Dodge Corp. reported last month that contracts awarded for building and engineering works in the first quarter in the 37 states east of the Rocky Mountains declined 9 percent from the corresponding period of last year. The 1949 first quarter total of building and construction awards was $1,799,070,000.

Despite the decline, the dollar volume total was the second highest for a first quarter on record, being exceeded only by last year's corresponding quarter. March awards were up sharply over the total for March of last year, and reduced considerably the margin of decline shown for the first two months of the year.

Nonresidential building as a group showed a gain of 1 percent in the quarter with a total of $771,219,000. The increase was attributable mainly to public building contracts—public administration buildings, post office buildings, armories, and similar structures—the total for which was $42,751,000.

Religious building awards increased 49 percent to a total of $53,942,000 in the first quarter. Other major nonresidential building classifications, with the exception of social and recreational buildings, showed declines ranging from 2 percent for educational buildings to 19 percent for manufacturing buildings.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Human Tolerance Limits for Extreme Heat

By W. V. Blockley* and Craig L. Taylor,** Los Angeles, Calif.

SUMMARY—The results of 21 human exposures to air temperatures ranging from 140 to 240 F are reported. The environments have been specified in terms of air and wall temperatures, air movement, and vapor pressure. Physiological measurements included skin, rectal and expired air temperatures, heart rate and body weight losses. The relationships between air temperature, exposure time, and an index of physiological strain, composed of heart rate and skin temperature, are displayed graphically. A comparison is made between the actual tolerance times and this index, as well as the extrapolated tolerance times from the studies made at the ASHVE Laboratory when it was located in Pittsburgh.

THE advent of aircraft with flight speeds in the sonic range presents the potential hazard of heat to pilots and occupants. In the event of failure of the air conditioning system, air entering the cabin would be heated in proportion to the square of the aircraft's speed. The orders of magnitude to be expected may be indicated by the following example: at low altitude on a 100 F summer day, air temperature in the cabin at a speed of 800 mph would rapidly reach 215 F.

Tolerance for extreme temperature is also a practical problem of industrial physiology and hygiene. Under special, though usually emergency, conditions workmen may be exposed to dry or humid heat. One of the authors has received a number of communications from individuals recounting such experiences. Though unverified, these accounts are adequately factual and not inconsistent with the results generally obtained in experimental situations. Thus a kiln technician reports many exposures for two or three minutes to 250 F, and on several occasions to 500 F. A plastics engineer regularly spends 10 min out of each 30 in an oven at 200 F. A mining engineer tells of rescue parties exploring pockets in a burning mine where temperatures ranging up to 240 F were encountered. These experiences outline the need for a knowledge of the human limitations, practical measures of personal protection, and for the development of efficient protective equipment.

In the literature of investigations into man's ability to withstand extreme thermal environments, accounts appear as early as 1775, when Charles Blagden and George Fordyce[1] reported on their experiments in heated rooms at temperatures up to 260 F. In modern times such studies have been mainly concerned with conditions involving high humidities but only moderately high dry bulb temperatures. Outstanding in the contributions to this field are the researches begun in the early 1920's at the ASHVE Laboratory in Pittsburgh, and one important aim of this paper will be to compare the results obtained in the present study with those of the ASHVE group. Other workers have studied reactions of working men to heat and high humidity, notably Dreosti[2], Eichna et al.[3] and Robinson[4].

Experimental Conditions and Procedure

The heat exposures discussed in this paper were carried out early in 1948 as part of a general program of research into man's ability to tolerate extreme heat.†

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**Associate Professor, Department of Engineering, University of California.

For presentation at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Minneapolis, Minn., June 1949.

[1]Exponent numerals refer to References.

†Work performed under contract with the U.S. Air Force, Air Materiel Command, Aero-Medical Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

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The experimental heat chamber is an insulated cylinder, 70 in. × 46 in. in diameter, with a total volume of 70 cu. ft. Ventilation and heating are accomplished by means of a blower, flow metering system, and a 9 kw electric heat exchanger. The flow through the chamber is distributed over its horizontal cross-section by a floor baffle plate system Its equivalent linear velocity, directed vertically from seat-to-head of the subject, averaged 41 fpm as measured with a thermal anemometer. The ventilation volume rate was maintained, as a matter of routine, at 70 cfm, exhaust air being discarded.

Air temperature was controlled by a thermocouple-potentiometer system with sensing element in the chamber. Wall temperature remained within 10 F deg of air temperature under all conditions. Humidity was not controlled, and the vapor pressure of the chamber air was a function of outdoor humidity and moisture added by the subject, ranging generally between 0.5 and 1.0 in. Hg and averaging about 0.8 in. Hg.

Two student volunteers were subjected to environments ranging in dry bulb temperature from 140 F to 240 F inclusive. In all these experiments, clothing was standardized, and consisted of a close-fitting wool and cotton one-piece union suit, 0.080 in. thick, with loose-fitting felt duffel socks on the feet.

Before each heat exposure, subjects spent at least 30 min resting in a comfort environment of approximately 80 F to establish baseline values for the physiological measures which were as follows:

1. Rectal temperature (t_r) obtained by a thermocouple inserted to 7 in.

2. Skin temperature, measured at nine locations and weighted according to the DuBois surface area factors to yield the mean skin temperature (t_s).

3. Exhaled air temperature, (t_e) measured at the mouth portal during channelled breathing (mouth exhalation).

4. Heart rate (H.R.) taken by means of 30 sec pulse counts at the wrist by the subject or counted from electrocardiographic records.

5. Respiration volume, oxygen consumption and respiration rate, taken from records of a closed circuit metabolism apparatus.

6. Blood pressure determined by standard auscultatory technique.

During the exposure period, determinations of the foregoing measures were made as frequently as possible —approximately every two to three minutes. Above 140 F, the subject remained in the test environment until the tolerance end point was reached as defined by the following:

1. Subject's report of intolerable discomfort. Under conditions of intelligent and manful cooperation from our subjects (which was at all times highly satisfactory), the authors believe that a practical limit was achieved. Certainly there was no evidence of terminating on whim or personal inconvenience. Sensations of heat or burning were never sole criteria for tolerance.

2. Appearance of symptoms of hyperpyrexia and heat exhaustion, including faintness, nausea, tingling sensations in extremities, mental confusion, compulsive restlessness, dyspnea or symptoms referred to the chest, when clearly developed.

3. Heart rate of 150 beats per minute. This was a physiological sign influencing the decision but was not used as an absolute criterion. That is, in the presence of other signs, experiments might be terminated at heart rates less than 150, but in some cases 150 was exceeded when the subject was otherwise in good shape.

The elapsed exposure time to this end point is referred to as *tolerance time;* it is significant that despite the inexact nature of this definition of tolerance, the tolerance times observed in different subjects at similar environmental conditions were invariably within 10 or 15 percent of each other.

The listed physiological responses were followed during the recovery after termination of the exposure.

Results

In Table 1 are summarized the environmental conditions and tolerance times for the 21 experiments of this series.

In Table 2 are shown physiological results obtained in a typical experiment, No. B-13, mean average air temperature 240 F; the detailed responses with time are graphed in Fig. 1.

The authors plan to publish separately a paper†† dealing in detail with the physiological aspects of heat exposure, but the following is a summary of findings up to the present time.

1. Skin temperature rises continuously during exposure, the rate of rise being successively greater with increasing ambient temperature levels. The maximum mean skin temperature observed was 107 F, reached in an exposure at 240 F.

2. Heart rate increases in a similar fashion to skin temperature, usually

††The work on which this paper is based is more fully described in an Air Force Technical Report entitled *Studies of Human Tolerance to Extreme Heat*—First Summary Report.

Table 1—Environmental Conditions and Tolerance Time

Mean Air Temperature (deg F)	Number of Exposures	Range of Inlet Vapor Pressures (in. Hg)	Range of Tolerance Time (minutes)	Average Tolerance (minutes)
140-142	2	0.075-0.36	63-64[a]	63.5[a]
154	1	0.12	79[a]	79[a]
179-181	4	0.14 -0.24	44-53	48.5
199-203	4	0.15 -0.32	31-35	33
218-224	6	0.17 -0.38	25-30	28
237-242	4	0.14 -0.51	20-26	23.5

[a]Terminated before tolerance was reached.

Table 2—Physiological Results Obtained in a Typical Experiment

Experimental Time (min)	Average Air Temp. (deg F)	Rectal Temp. (deg F)	Expired Air Temp. (deg F)	Mean Skin Temp. (deg F)	Heart Rate	Blood Pressure (mm Hg)
Pre-exposure (start = 0 time)						
30	80	97.8	95.7	95.0	80	128 80
Exposure (start = 0 time)						
3	228			100.5	104	
6	238	98.2	98.4	101.5		
10	245	98.6	100.8	102.1	114	
15	245	99.3		103.3		
18	242	99.9	102.8	104.1	150	
24	242	100.8	105.6	105.0	150	
25		101.1				
26 Tolerance Time.						
Recovery (time continued)						
29	75				132	180 90 60
41	75	99.3		95.3	88	100 50
44	75	100.4	98.0	96.8	92	118 80
62	75		95.7	93.2		122 88

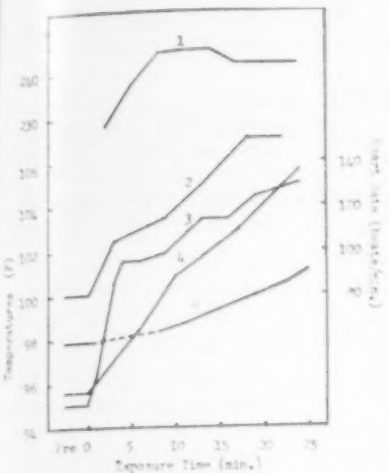

Fig. 1—Experiment B-13: curve 1, air temperature; 2, heart rate; 3, mean skin temperature; 4, expired air temperature; 5, rectal temperature

reaching values between 140 and 160 beats per minute.

3. Blood pressure changes show greater individual differences than do other physiological factors. Systolic pressure rose during exposure in all cases, while diastolic pressure declined continuously in one subject, but remained relatively stable or slightly elevated in another.

4. Electrocardiograms taken during and after heat exposure show minor variations from the normal resting records of the individual, but no distinct indications of heart damage have been seen.

5. Rectal temperature changes are relatively slight and slow in onset as compared with other physiological reactions, and are an unreliable indication of the extent of heat stress on the body under these conditions of short exposure.

6. Exhaled air temperature responds rapidly to the heat load, and appears to be a useful indication of thermal stress. Measurement of temperatures at several locations in the respiratory passages indicates that the mucous membranes exert a strong regenerator influence, cooling the inhaled air by as much as 100 F in a few inches of travel, and warming the exhaled air, though to a much lesser degree. However, as far as can be determined, because of the evaporative loss the total respiratory system continues to serve as an avenue of heat loss even under conditions close to the extremes of these studies.

7. Respiratory ventilation increases markedly under heat stress, often reaching values two or three times the resting levels, though respiration rate is not significantly affected. Oxygen consumption apparently follows a course roughly parallel to that of ventilation.

8. The rate of sweat loss is highly variable, but tends to increase with successively higher levels of ambient temperature. The rate of actual evaporation increases with air temperature at a considerably slower rate than does the total weight loss. Absolute values of the weight loss observed range from 0.9 to 2.5 lb depending on the characteristics of the individual, the duration of exposure, and the ambient temperature level.

9. Subjective symptoms of thermal strain are numerous, but only a relatively few were observed consistently in each experiment. Some sensations, while definite, are difficult to describe in precise terms. One common feature of all exposures carried to tolerance is a feeling of air hunger, associated with deep and irregular respiration. This symptom may be accompanied by restlessness and nervous irritability, while waves of dizziness may intervene at terminal stages.

Items 1, 5 and 6 deserve emphasis, since they illustrate the main difference in effect between the short-term, high dry bulb environments studied by the authors and the high humidity, moderate dry bulb environments which were used in the majority of the Pittsburgh ASHVE studies. Table 3 illustrates the tendency of surface temperature to outstrip rectal temperature as the severity of the heat load is increased.

In the authors' experiments the maximum rectal temperature recorded was 101.7 F. In many cases the peak temperature was reached after exposure, during the recovery period, and in several exposures it did not exceed the normal range.

Index of Physiological Strain

For the purpose of clarifying the relationship between physiological responses and air temperature, the collected data were analyzed at a particular exposure time. Exposure time 20 min was selected as the comparison point, in order to avoid early adjustment effects and yet include all experiments. Values for the various physiological measures at 20 min were read from the response-time curves, while in the case of air temperature the value for the whole experiment was used.

The correlation coefficients are shown in the following tabulation:

(1) Heart rate with air temperature	0.91
(2) Mean skin temperature with air temperature	0.96
(3) Rectal temperature with air temperature	0.64
(4) Exhaled air temperature with air temperature	0.89
(1) + (2)* with air temperature	0.96
(1) + (2) + (3) with air temperature	0.92
(1) + (2) + (4) with air temperature	0.98

*For the purpose of the combinations, Z scores were computed according to the formula, $Z = (x - M_x)/S_x$, where x = a variate, M_x = the mean and S_x = standard deviation of the distribution of the variates. The Z score corresponds to the *relative deviate scale, k*, as defined and derived by Treloar, *Elements of Statistical Reasoning*, 1939; it allows the expression of a series of quantities as pure numbers, so that the problem of dissimilar units is eliminated. All other statistical methods and symbols used in this paper are fully explained in the latter work.

The results show that the combination of skin temperature and heart rate, equally weighted, yields a coefficient of 0.96. Adding t_r slightly improves the relationship, but this combination was discarded because of the fewer cases containing determinations of t_r. Rectal temperature reduced the relationship, as might be expected from the preceding results.

If it is assumed that the conclusions from the analysis of 20-min data hold approximately for any time up to 35 min, a simple index of physiological strain can be derived, namely

$$\text{Index} = \tfrac{1}{2}\,(Z_{t_s} + Z_{\Delta HR}).$$

To this end, means and standard deviations for the total distributions

Table 3—Increase of Surface and Rectal Temperature with Effective Temperature

Effective Temperature	Δt_r (deg F/hr)	t_r	Δt_s (deg F/hr)	t_s	ΔHR (beats/min/hr)
90	0.4	99.0	0.4	96.4	3
95	0.9	99.5	1.2	97.2	11
100	2.1	100.7	3.3	99.3	42
105	4.0	102.6	8.8	104.8	98

Δt_r (increase in rectal temperature) and ΔHR (increase in heart rate) values were read from Fig. 5 and Fig. 6 (Houghten and Yaglou[5]).
Δt_s (increase in skin temperature) was calculated from Fig. 3 (McConnell and Yaglou[6]).
$t_r = 98.6 + \Delta t_r$; $t_s = 96.0 + \Delta t_s$; one hour exposure assumed.

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($N = 102$) of skin temperature and heart rate were calculated, as follows:

HR: mean = 109.4; standard deviation = 18.26

t_s mean = 101.6; standard deviation = 2.53

Substituting and simplifying:

$$\text{Index} = 0.0274\ (\text{HR}) + 0.198\ (t_s) - 23.10$$

Sensible Heat Transfer

In the experiments reported here it was not possible to incorporate routine measurements of evaporative heat loss and metabolism, and consequently complete heat balances cannot be reported. Radiant and convective heat transfers from chamber walls and air to clothing surface have been calculated by the equation,

$$q_r + q_c^* = h_r\ (t_w - t_c) + h_c\ (t_a - t_c)$$

where

q_r, q_c = radiant and convective heat transfers Btu per (square foot) (hour)

t_c, t_a, t_w = garment surface, air and wall temperatures (F deg)

Since, in a steady state, the same quantity of heat must be conducted through the clothing, this relation is expressed:

$$q_r + q_c = h_g\ (t_c - t_s)$$

where

t_s = skin surface temperature (F deg)

Solving the two equations for t_c, setting them equal, and solving for $q_r + q_c$, gives the expression for overall heat transfer from environment to body:

$$q_r + q_c = \frac{h_g\ (h_r t_w + h_c t_a - h_r t_s - h_c t_s)}{h_c + h_r + h_g}$$

where

h_g = unit conductance of garment, Btu per (square foot) (hour) (F deg temperature difference between surfaces of clothing)

h_r = unit heat transfer by radiation, Btu per (square foot) (hour) (F deg temperature difference between wall and garment)

h_c = unit conductance for thermal convection, Btu per (square foot) (hour) (F deg temperature difference between air and garment surface)

Coefficients of heat transfer h_c, h_r, h_c for the test conditions reported have been adapted as follows:

$$h_r = \frac{\sigma F_{es}\ (A_r / A_b)\ (T_g^4 - T_w^4)}{t_g - t_w}$$

Btu per (square foot) (hour) (F deg per foot)

where

F_{es} = 0.57 (This shape-emissivity modulus is based upon the emissivities of garment and walls)

σ = Stefan-Boltzmann radiation constant

A_r/A_b = 0.75 (the fraction of body area concerned in radiation as taken from Winslow et al[2])

h_c = 0.020 $V^{\frac{1}{2}}$ Btu per (square foot) (hour) (F deg)

where

V = air velocity feet per hour. This equation is also taken from Winslow et al[2], and modified to the temperatures (200 F) of these experiments

$$h_g = k\frac{1}{L}$$

where

k = thermal conductivity of garment Btu per (square foot) (hour) (F deg per foot)

L = garment thickness, feet. According to Schiefer et al[3] for the 50:50 cotton-wool underwear used in these experiments is 0.028, and L from the authors' measurements at 0.1 lb per square inch is 6.83×10^{-3} ft.

Values of $q_r + q_c$ then represent an external heat load expression.

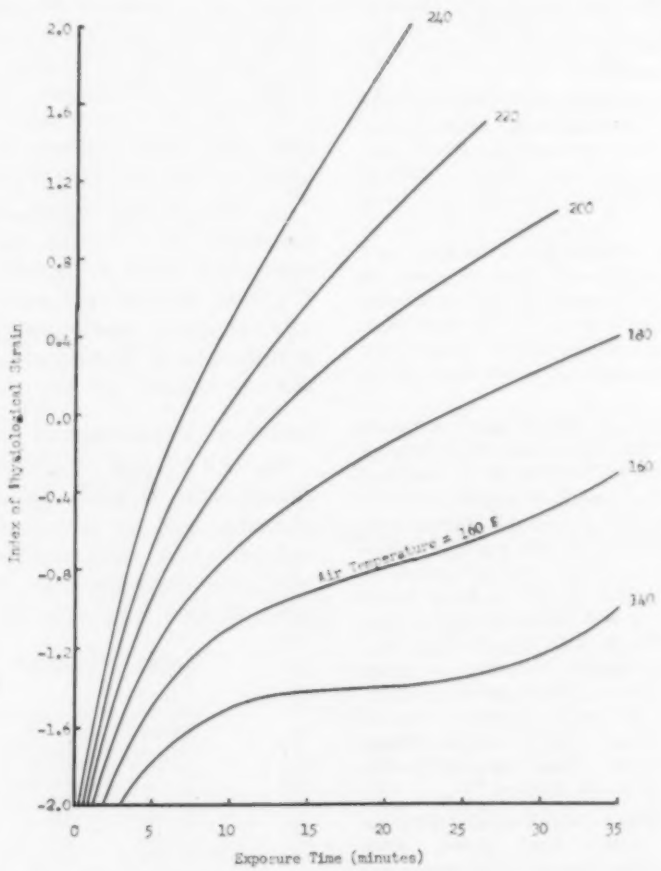

Fig. 2—Relationships between average Index, air temperature, and time of exposure

Data are based upon two subjects exposed a total of 18 times, approximately two to three times to each air temperature

*It will be noted that for clarity in presenting a portion of the human heat balance the equations have been rearranged to give a positive sign to $q_r + q_c$. In conventional treatments of the total heat balance, this quantity would bear a negative sign when the environment is hotter than the body surface (see HEATING, VENTILATING, AIR CONDITIONING GUIDE 1949, p. 216).

with which the physiological effects and tolerances may be correlated.

Relations Between Heat Load Criteria and Index of Physiological Strain

The data from 18 experiments were separately analyzed at 5, 10, 15, ... 35 min of exposure time as a means of determining the relations between heat load criteria and index of physiological strain. Coefficients of correlation were obtained for each 5 min period, (*a*) between chamber air temperature and Index, and (*b*) between $q_r + q_c$ and Index. It was found that these coefficients agreed closely throughout. For example, at 20 min, correlation (*a*) was 0.96, correlation (*b*) was 0.95. From this it was concluded that the present data could most conveniently be treated in terms of the air temperature criterion.

Relations Between Exposure Time, Air Temperature, and Strain Index

Since in the temperature range concerned, the practical problem is one of time-tolerance, it is necessary (*a*) to examine the changes in physiological state with time, and (*b*) to determine the relationships between the maximum tolerable index of strain, exposure time, and air temperature.

The first of these comparisons is displayed in Fig. 2, a plot of Index versus time for the various air temperature groups. Since the exposure temperatures were originally planned for 20 F intervals from 140 to 240 F (except 160), and the mean air temperatures actually obtained seldom varied more than ±3 deg from the designated temperature, it is possible to construct a simple family of curves. The points along each 5 min time line were computed from the least square linear fits made between air temperature and Index for each 5 min block of data. Because of the data at hand, this time function is presented graphically. With more experiments, mathematical analysis of time trends will be justified. It is clear that increasing emphasis must be given to time rates for each mode of adaptation in evaluating tolerance for short intense exposures.

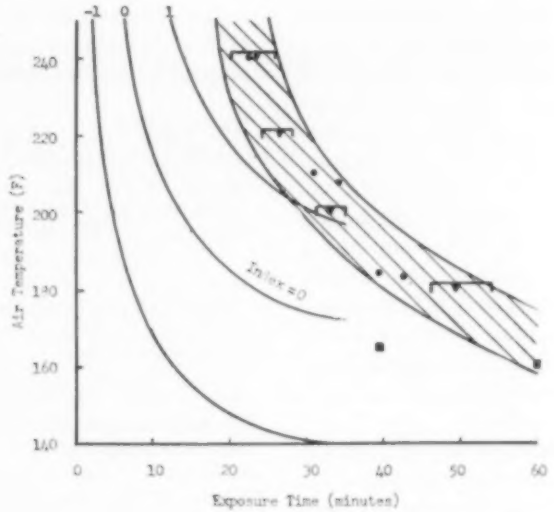

Fig. 3 — Contours of Index and tolerance time. Brackets and arrows indicate range and means of UCLA tolerance times; solid circles, McConnell et al[9] (see text for explanation); solid squares, Taylor et al[10]

Tolerance Contours

With a view toward displaying the salient features, Fig. 3 has been constructed by reading points from Fig. 2, presenting Index as a function of ambient air temperature and exposure duration. Plotted upon this figure are the actual tolerance times of the experiments. One immediately sees that these tolerance times do not correspond to any constant Index level, but appear to increase in Index with air temperature. This means that factors additional to heart rate and skin temperature have to do with the tolerance time. It will be recalled from the preceding discussion that numerous and diverse symptoms are associated with tolerance. These are not necessarily highly correlated with Index.

For comparison, the results of two other investigations featuring suitably similar conditions of exposure have been included in Fig. 3. Tolerance times averaged from still air, 200 fpm and 400 fpm air velocity exposures at various effective temperatures have been taken from McConnell, Houghten and Yaglou[9], Table 3. These differences in air movement apparently had no effect upon tolerance time, according to the authors, and advantage may be taken therefore of the larger number of cases in their combined[10] results. The effective temperature chart was used to extrapolate the effective temperatures to the equivalent temperature at a vapor pressure of 0.8 in. Hg which is the average of our experiments. This temperature, together with the tolerance time, could then be plotted on Fig. 3.

Results from Wright Field exposures[10] are also plotted. These give a point at 60 min, which represents tolerance for 7 experiments, and an average tolerance time of 39 min obtained in 5 other experiments. These tolerance times were also entered at an ambient temperature (at 0.8 in. Hg vapor pressure) equivalent in physiological effect to those of the actual exposure. An equation of equivalence, given in the reference cited, was used to make the necessary conversions.

The plots of Fig. 3 show that there is fair general agreement between the three sets of data, although it should be noted that the 39 min tolerance point from the Wright Field data is apparently at variance. There is no immediate

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explanation for this discrepancy. The cross-shaded area represents a zone, within which individuals will reach tolerance at some time depending upon motivation, state of fitness, and numerous other factors which are as yet obscure. No attempt has been made to formulate the shape of the curve, nor has a safe tolerance line been established, beyond that implied in the inner limit of the shaded area. Such a tolerance limit will be offered when more experimental results have been accumulated.

It should be emphasized that the tolerances strictly apply only to the conditions of the experiments, particularly with respect to the limited humidities. Advantage, however, may be taken of the general agreement with ASHVE and Wright Field results to extend the tolerance lines to other temperature and humidity combinations, with the aid of the criteria of equal effect explained in the original papers.

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9. Air Motion—High Temperatures and Various Humidities—Reaction on Human Beings, by W. J. McConnell, M.D., F. C. Houghten and C. P. Yaglou. (ASHVE TRANSACTIONS, Vol. 30, 1924, p. 167.)
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DOWNES CHOSEN AS STATE ENGINEER

The new supervising engineer for the state of California is Nate W. Downes, Kansas City, Mo., ASHVE member since 1917. Mr. Downes made one of the three highest grades in a competitive examination for the position, and was chosen from the three by the California state civil service board. He has had 35 years of experience in the district engineering service of Kansas City. Before being named to the new position, Mr. Downes was assistant superintendent of schools in charge of buildings and grounds.

He was on the ASHVE council 1928-1930, and is a past president of the Kansas City Chapter.

AIR CONDITIONING IN DENTAL OFFICES

Air conditioning, which provides several advantages in addition to the important factor of comfort, has been studied in a recent survey by *Oral Hygiene Publications*. The survey included 400 dentists in 23 states.

Thirty-three percent were dentists with single operating rooms and 50 percent had two rooms. Although air conditioning was installed primarily in the operating rooms, many dentists said that they were planning to install equipment for their complete offices.

Installations of air conditioning units dated back to 1928, but most of the units have been installed since the war. Sixty-two percent of the dentists surveyed had air conditioning in use for the last two years.

Important advantages included the comfort of patients during hot weather, with increased efficiency of dentists and cooperation on the part of patients. Materials such as zinc-oxide cement, silicates, and various impression materials are more or less affected by temperature and humidity, the survey stated. Air conditioning improved the manipulation of these materials.

Cleanliness was made easier, because during hot weather windows could be kept closed, eliminating the possibility of dust, insects and pollen.

John R. Allen Memorial Library

The ASHVE Committee on Research gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

Odors—Physiology and Control, by Carey P. McCord and William N. Witheridge (1949). Gifth of Mr. Witheridge.

Proceedings of the National District Heating Association (1948). Gift of the *NDHA*.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

Earth as a Heat Source or Storage Medium for the Heat Pump††

By E. W. Guernsey*, P. L. Betz** and N. H. Skau†, Baltimore, Md.

SUMMARY — General relationships have been developed between rates of heat flow and temperature either where heat is withdrawn from earth to a heat transfer surface at a constant rate or is withdrawn and returned to earth in a cyclic manner. Both flat and cylindrical surfaces are considered. On the basis of the results, it is doubted that ground coils will be economic for general use.

THE FUTURE development of space heating by the heat pump is to a considerable degree dependent on the successful adaptation of available heat-sources. There has been some tendency, when apparent difficulties in the use of air, well water or other heat-sources have been recognized, to look to the use of a heat exchanger buried in the earth as a more promising source. It is the purpose of this paper to examine critically some of the factors which would be expected to determine the practicability of such earth heat-sources. The paper will be primarily concerned with the results of a series of calculations of heat flow under various specified conditions and over extended periods of time when the supply of heat depends solely on heat capacity of the soil and conduction through the soil.

It is believed that heat capacity and thermal conductivity are the most important factors, and that the results may therefore be directly useful as indicating the limitations of ground coils for *general* use. There may be, of course, special coil locations, as for example near ground water streams, where there are important contributions to heat supply not related to heat capacity and heat conduction. In such special cases the calculations of the present paper may be less useful.

Assumed Conditions

Solutions are presented in general terms to permit application to various sets of circumstances. In addition, however, detailed calculations for particular assumed conditions are shown in order to give an immediate indication as to the practical outlook. The particular conditions are in general such as to give minimum values for the required heat transfer surface. Thus, the surfaces are assumed to be located in a highly conducting, rather wet soil, (25 to 30 percent moisture) having the properties:[1] k, 0.896; c_p, 0.45; ρ, 103; α, 0.0193.

It is assumed further for the sample calculations that 50,000,000 Btu of heat are to be extracted from the earth annually. This corresponds to the case of a small, well-insulated house in an area where the minimum temperature is 0 F, the temperature deficiency is 4500 degree days per season, the total heating requirement is 75,000,000 Btu, and the coefficient of performance of the heat pump is three.

It is generally assumed for the calculations that the temperature of the heat transfer surface may deviate from the normal average earth temperature as much as 40 F.

Several idealized cases may now be considered, these being such as to permit precise solution and at the same time to correspond as nearly as possible to some particular practical situation. This permits the application of the results of the calculations with a minimum of arbitrary adjustment.

Constant Heat Withdrawal From Cylindrical Surface

Case 1: Heat is withdrawn at a constant rate at a cylindrical surface in contact with earth of infinite extent and uniform initial temperature. Effects of cylinder ends are ignored; these effects become smaller as cylinder length increases. No account is taken of effects of heat interchange with atmosphere, which are small for the case of a long cylinder extending vertically into the earth.

It has been found that, except for a short initial period, the temperature at the surface of small cylinders or in the soil is the same, within negligible error, as it would be if the heat were extracted at the axis instead of at the surface of the cylinder. (The error introduced in the calculation of cylinder surface temperature by this approximation becomes less than 1 percent when time, t, is greater than $\frac{10r^2}{\alpha}$). The temperature at various points may therefore, for practical purposes, be calculated from the Equation:[2]

$$\theta = \frac{A}{5.4575\,k}\int_{-\infty}^{\log_{10}\frac{\alpha t}{r^2}} e^{-\frac{r^2}{4\alpha t}}\, d\log_{10}\left(\frac{\alpha t}{r^2}\right) \qquad (1)$$

The temperature change, θ_s, at the surface of the cylinder has a special interest, since in the practical use of the cylinder as a heat-source for the heat pump, the design would have to be such that the heat receiving surface would not fall below an acceptable minimum

††Abstract. Complete paper to be published in the 1949 TRANSACTIONS.

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For presentation at the Semi-Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, June 1949.

[1] Exponent numerals refer to References.

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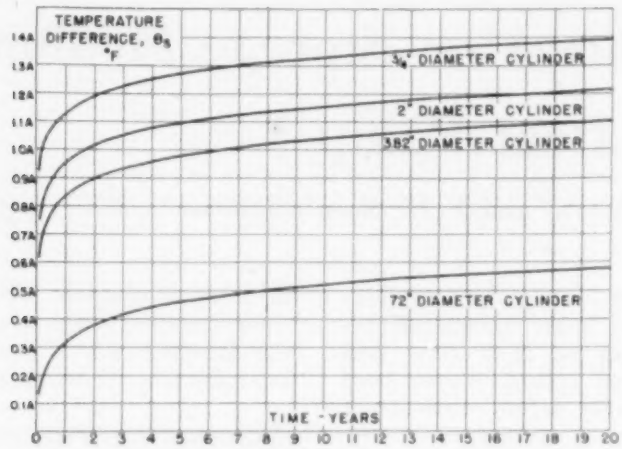

Fig. 1 — Temperature difference between surface of cylinders and initial earth temperature as related to time
Heat absorption rate = A Btu/(hr)(linear ft). Earth constants: k = 0.896, c_p = 0.45, ρ = 103, α = 0.0193

temperature after an extended period. Such temperatures may be found by inserting values for r in Equation 1 corresponding to the radii of the cylinders of the various sizes which may be considered. The equation was solved with the aid of available tables[3] giving the values of a related integral. An empirical expression has been developed giving the value of the integral with negligible error for values $\log_{10}\frac{\alpha t}{r^2}$ greater than one. Using this, Equation 1 becomes

$$\theta = \frac{A}{5.4575k}\left[\log_{10}\frac{\alpha t}{r^2} + 0.106\frac{r^2}{\alpha t} + 0.351\right] \quad --(2)$$

The relations between pipe surface temperature and time, through an initial 20-year period, are shown in the curves of Fig. 1.

It will be seen that at the beginning of the withdrawal of heat from earth, the temperature changes rapidly at the surface of the cylinder, but much less rapidly as time proceeds. It is shown that increasing the cylinder diameter results in a relatively small decrease in the temperature difference between initial ground temperature and cylinder surface temperature.

Application of Curves

The application of these curves may now be illustrated. It is assumed that an installation for supplying earth-heat to a heat pump would be considered unsatisfactory unless it is able to maintain the heat supply for at least 20 years. It is indicated in Fig. 1 that the surface of the 3.82 in. diameter tube (1 sq ft area per linear foot) for example, has dropped at the end of 20 years to 1.1 A deg below the original uniform ground temperature; that is, the drop in degrees is 1.1 times the continuous rate of heat extraction in Btu per hour per linear foot of cylinder.

If it is permissible for the heat absorbing surface to drop at the end of 20 years to a temperature 40 F below the original ground temperature, the corresponding rate of heat withdrawal, A, would be $\frac{40}{1.1}$ = 36.3 Btu per (hour) (foot). If the yearly withdrawal of 50,000,000 Btu were at a uniform rate, that is, $\frac{50{,}000{,}000}{8760}$ = 5710 Btu per hour, the indicated length for 20 years of continuous operation would be $\frac{5710}{36.3}$ = 157 ft for the 3.82 in. diameter cylinder. The corresponding lengths indicated for cylinders of the various sizes shown in Fig. 1 are found to be as follows:

Diameter—In.	¾	2	3.82	72
Length for Continuous Withdrawal of 5710 Btu per (hour) (foot) —Ft	198	174	157	83

Ingersoll and Plass[4] have shown a similar calculation for continuous heat withdrawal from two soils. The actual lengths required in a practical case would be substantially more than those given here, not only because the soil characteristics, the annual heat requirement

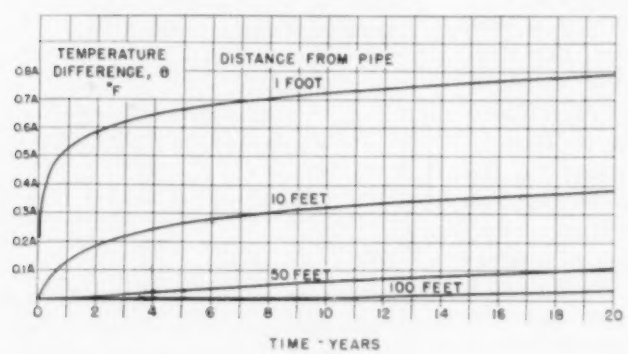

Fig. 2 — Temperature change from initial earth temperature at various distances from small diameter cylinder as related to time
Heat absorption rate = A Btu/(hr)(linear ft). Earth constants: k = 0.896, c_p = 0.45, ρ = 103, α = 0.0193

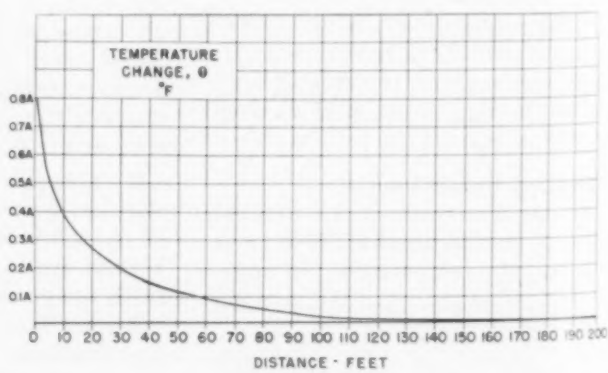

Fig. 3 — Temperature change from initial earth temperature around a buried cylinder of small diameter after 20 years' operation as related to distance from cylinder
Heat absorption rate = A Btu/(hr)(linear ft). Earth constants: k = 0.896, c_p = 0.45, ρ = 103, α = 0.0193

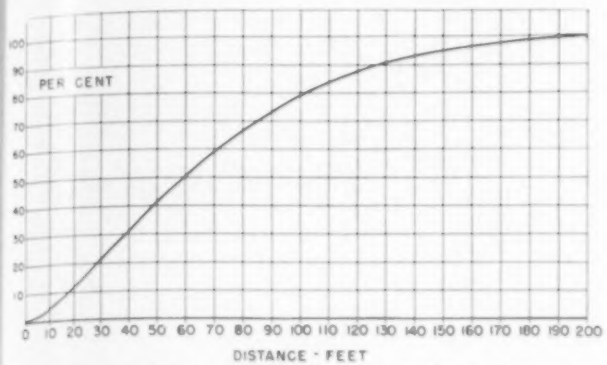

Fig. 4 — Cumulative contributions to total heat absorption over a 20-year period as related to distance from center of small diameter cylinder

Heat absorption rate = 4 Btu/(hr)(linear ft). Earth constants: $k = 0.896$, $c_p = 0.45$, $\rho = 103$, $\alpha = 0.0193$

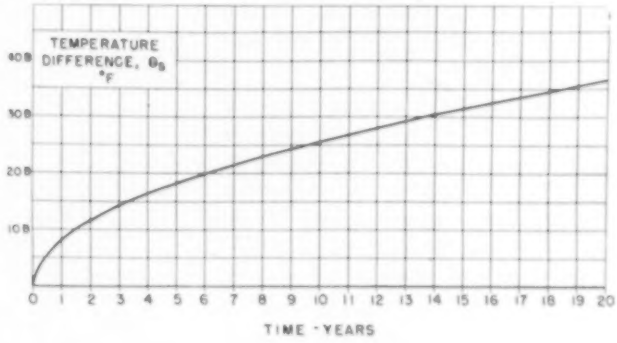

Fig. 5 — Temperature difference between surface of flat plate and initial earth temperature as related to time

Heat absorption rate = B Btu/(hr)(sq ft). Earth constants: $k = 0.896$, $c_p = 0.45$, $\rho = 103$, $\alpha = 0.0193$

and the allowable temperature variation would often be less favorable than assumed, but especially because the yearly heat withdrawal would be largely concentrated in a few winter months and not spread uniformly over the year. The probable magnitude of the correction for the effect of the deviation from constancy in the actual heat withdrawal schedule will be considered at a later point.

In addition to determining the course of the temperature change at the cylinder surface with time, it is possible to determine temperature changes in the soil at various distances from the cylindrical surface. For these changes Equations 1 and 2 are applicable, and these relationships are shown in Fig. 2. In Fig. 3 the distribution of temperature through the soil at the end of 20 years is shown.

Such data are pertinent to the determination of space required between two or more cylinders in order that they will not in time interfere with each other. Further analysis of the data in Fig. 3 permits calculation of the portion of the total heat supply for a 20-year period which is drawn from each of the various shells of earth surrounding the cylinder.

The cumulative contributions of the various shells are shown in Fig. 4. The curves of Figs. 2, 3, and 4 are applicable for cylinders of any size and for any rate of heat transfer considered in this study, but would require modifications for soil having properties other than those assumed. For example, it is seen from Fig. 4 that in an initial 20-year period about 60 percent of the total heat required would be drawn from the soil at distances greater than 50 ft, and over 20 percent of the total heat required would come from distances greater than 100 ft. It is clear, therefore, that if heat is withdrawn over a long period with no off-setting return of heat, it would not be feasible for several close neighbors each to draw on the earth's heat.

Likewise the cylinder lengths derived earlier in this paper are to be understood as applying to the case of a single continuous cylinder, as for example, one placed vertically in the earth, that is, the indicated lengths *could not* be changed into two or more shorter lengths unless wide spacings between the separate portions were maintained. This conclusion would be the same with partial return of heat if there were still a substantial unbalance between heat withdrawn and returned. On the other hand, it will be indicated later in this paper that such interference between neighboring units is much less marked if the quantities of heat withdrawn from and returned to earth are equal.

Constant Heat Withdrawal From Planar Surface

Case 2: Heat is withdrawn at a constant rate from an infinite planar surface in contact with earth of infinite extent in both directions from the surface and at uniform initial temperature. Since edge effects are ignored, the solution of this problem will be more accurate the larger the surface used.

A practical analogue to the case considered is a grid of small pipes so closely spaced that they act in effect as a heat receiving plate. It is not within the scope of this paper to demonstrate the spacing of pipes required. It may, however, be said briefly that for this case of constant rate of withdrawal of heat, a spacing of three or four feet between pipes is the near-equivalent of a plate.

An equation applicable to this case is given by Carslaw and Jaeger[5] as

$$\theta = \frac{B}{2k}\sqrt{\frac{\alpha}{\pi}}\int_0^t e^{-\frac{x^2}{4\alpha t}}\frac{dt}{\sqrt{t}} \qquad (3)$$

For the special case of the planar surface where $x = 0$, Equation 3 becomes

$$\theta_s = \frac{B}{k}\sqrt{\frac{\alpha t}{\pi}} \qquad (4)$$

If the same soil properties are assumed as were used in the calculations relating to the cylindrical heat transfer surfaces, the relation over a 20-year period between temperature at the heat transfer surface and time for any given heat withdrawal rate, B, is as shown in Fig. 5. With the planar surface a much smaller part of the total

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temperature change occurs in the early years than with cylindrical surfaces (Fig. 1).

If it is again assumed that the temperature of the heat transfer surface may drop at the end of 20 years to a point 40 F below the original soil temperature, it is found (noting that the value of the ordinate of the curve at time = 20 years is 36.5 *B*), that the rate of heat extraction, *B*, may not be more than $\frac{40}{36.5}$ Btu per hour per square foot of plate. The plate area for continuous heat withdrawal of 50,000,000 Btu per year for 20 years at a constant rate is hence $\frac{50,000,000}{8760} \times \frac{36.5}{40} = 5210$ sq ft. This is for the case where heat is flowing to the plate from both directions, as when the plate is placed vertically in the earth. The total heat receiving surface would thus be about 10,500 sq ft, under the generally favorable conditions assumed.

The plate size needed to supply heat on an actual schedule of requirement would of course be increased. It is estimated, however, that the increase would be relatively small, perhaps one-fourth. There is apparently an extensive and available reserve to meet peaks in demand for heat, with only slow drop in temperature in the vicinity of the planar surface. This is not the case with the cylindrical surface.

Periodic Withdrawal and Return at Planar Surface

Case 3: Heat is periodically withdrawn from and returned to the earth at a planar heat transfer surface as provided by a plate at such a rate that the temperature of the surface varies sinusoidally with time. The amounts of heat extracted and returned are the same. The earth is thus considered essentially as a heat storage medium rather than as a heat-source. If the heat which would be returned to the earth, incidental to summer cooling, is less than the heat required from the earth for winter heating, the deficiency is to be made up, as for example from summer heat.

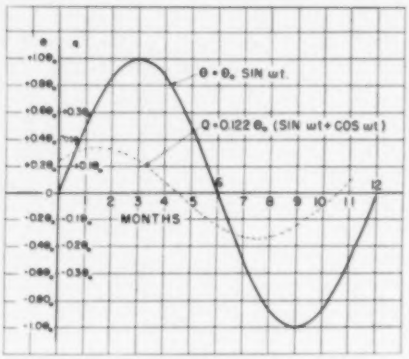

Fig. 6 — Heat flow rate at the surface of a buried plate for a sinusoidal temperature variation of the plate

Earth Constants: $k = 0.896$, $c_p = 0.45$, $\rho = 103$, $\alpha = 0.0193$

Here again, the practical analogue of a plate of a given area is a grid of small pipes sufficiently close and covering the same area.

Following the method outlined by Ingersoll and Zobel[6], it may be shown that as the temperature of the planar heat transfer surface, θ_s, is varied sinusoidally, (that is, according to the relationship $\theta_s = \theta_0 \sin \omega t$) the flow of heat to and from the heat transfer surface is described by the equation:

$$Q = k\sqrt{\frac{\pi}{\alpha t}}\,\theta_0[\sin\omega t + \cos\omega t] \text{----(5)}$$

The imposition of a sinusoidal variation in either heat flow or temperature has thus the effect of causing, after an initial period of a few years, both the temperature of the heat transfer surface and the heat flow to vary sinusoidally, the curve for heat flow leading that for temperature by 1½ months, as shown in Fig. 6.

The assumption of a sinusoidal variation in heat flow to and from a ground coil for heat pumps would appear to be reasonable as a first approximation, in view of the fact that the atmospheric temperature to which heating and cooling requirements are related, follows a sine curve quite closely, as shown in Fig. 7. It is true that the actual schedule of heat flow to and from earth which would be required for the heat pump would deviate in practice from the sine curve. A consideration of the effect of these deviations indicates that the actual cylinder length required should be somewhat greater than for the idealized *Case 3*.

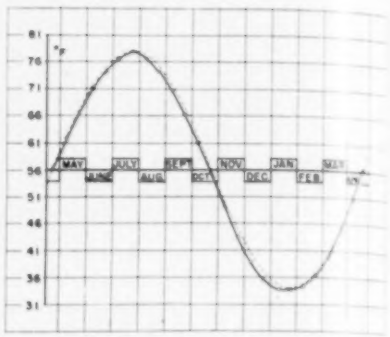

Fig. 7 — Average semi-monthly temperatures for Baltimore showing closeness of seasonal variation to a sinusoidal curve

(Points shown are averages for 46 years, 1875-1921, dotted curve is a theoretical sine curve.)

For soil of the same favorable properties as those assumed in the previous examples, Equation 5 becomes

$$Q = 0.122\,\theta_0(\sin\omega t + \cos\omega t) \text{---(6)}$$

The total heat flow, *W*, into or out of the earth corresponding to one loop of the sinusoidal heat flow curve (see Fig. 6) is

$$W = 0.122\,\theta_0 \int_{t=\frac{3\pi}{4}}^{t=\frac{7\pi}{4}} (\sin\omega t + \cos\omega t)\, d\omega t \text{----------(7)}$$

For soils having properties other than those assumed here, other constants would be obtained instead of the value 0.122.

If as in other examples it is assumed that a variation from original soil temperature of 40 F is permitted, (that is, $\theta_0 = 40$ F) the value of *W* is found to be 19,240 Btu per sq ft. For a seasonal heat withdrawal from the earth of 50,000,000 Btu, the indicated minimum requirement of planar heat transfer surface is $\frac{50,000,000}{19,240} = 2600$ sq ft. If the surface is in the effective form of a plate so disposed that two surface areas are active, the mini-

mum extent of plate required would be one-half, or about 1300 sq ft.

Periodic Withdrawal and Return at Cylindrical Surface

Case 4: Heat is periodically withdrawn from and returned to the earth in equal amounts at a cylindrical heat transfer surface at such a rate that the temperature of the surface varies sinusoidally with time. Here, as in *Case 3*, the earth is used as a heat storage medium rather than as a primary heat source.

The fundamental differential equation for heat flow to or from a cylindrical surface in contact with an infinite solid is,[7]

$$\frac{\partial^2\theta}{\partial r^2}+\frac{1}{r}\cdot\frac{\partial\theta}{\partial r}=\frac{1}{\alpha}\cdot\frac{\partial\theta}{\partial t}=0 \quad \text{-----(8)}$$

By a derivation the presentation of which is beyond the scope of this paper, but which is adapted from McLachlan,[8] and from Carslaw and Jaeger,[9] taking account also of the condition that $\theta_a = \theta_o \sin \omega t$, it is found that

$$\theta=\theta_o\frac{N_o\left(r\sqrt{\frac{\omega}{\alpha}}\right)}{N_o\left(a\sqrt{\frac{\omega}{\alpha}}\right)}\sin\left[\omega t+\varphi_o\left(r\sqrt{\frac{\omega}{\alpha}}\right)-\varphi_o\left(a\sqrt{\frac{\omega}{\alpha}}\right)\right] \quad \text{---(9)}$$

and

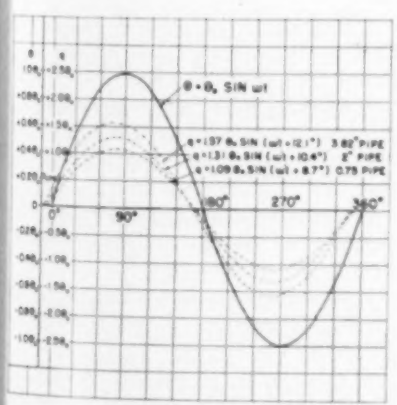

Fig. 8 — Variation of heat flow rate at the surface of buried pipes of different diameters when the temperature at the pipe surface varies sinusoidally

Earth Constants: $k = 0.896$, $c_p = 0.45$, $\rho = 103$, $a = 0.0193$

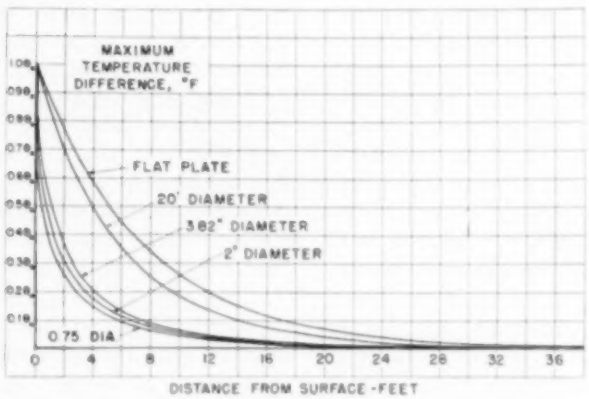

Fig. 9 — Maximum variation from base temperature at points in the earth removed from pipe

For sinusoidal variation at the surface and earth constants: $k = 0.896$, $c_p = 0.45$, $\rho = 103$, $a = 0.0193$

$$q=2\pi a\theta_o k\sqrt{\frac{\omega}{\alpha}}\,\frac{N_1\left(r\sqrt{\frac{\omega}{\alpha}}\right)}{N_o\left(a\sqrt{\frac{\omega}{\alpha}}\right)}\sin\left[\omega t+\varphi_1\left(r\sqrt{\frac{\omega}{\alpha}}\right)-\varphi_o\left(a\sqrt{\frac{\omega}{\alpha}}\right)+\tfrac{1}{4}\pi\right] \quad \text{----------(10)}$$

Temperatures, θ_a, and heat flow rates, q_a, at the cylinder surfaces are obtained by substituting $r = a$.

Values of the functions N_o, φ_o, N_1, φ_1 are given by McLachlan and Meyers.[10] When these values are substituted in Equation 10, relationships between heat flow at the surface and time are obtained as shown in Fig. 8. By integration, the total heat flow into (or out of) the cylinder in one season, corresponding to one loop of the sine curve is found to be as follows:

Cylinder Diameter —In.	¾	2	3.82
Seasonal Heat Flow—W'—Btu/ft	3040 θ_o	3665 θ_o	4380 θ_o
Seasonal Heat Flow for $\theta_o = 40$, W'40—Btu/ft	121,600	146,600	174,200

If now, as in the preceding examples, it is assumed that a temperature variation from original earth temperature of 40 F is to be permitted, (that is, $\theta_o = 40$) and that the total heat withdrawn (or returned) in one season is 50,000,000 Btu, then the indicated lengths of cylinder, L, required are, $\frac{50{,}000{,}000}{W'_{40}}$, or:

for ¾ in. pipe $L = 411$ ft
for 2 in. pipe $L = 342$ ft
for 3.82 in. pipe $L = 286$ ft

The cyclic temperature variations in the soil resulting from the imposed heat flow at the cylindrical surface may be calculated from Equation 9. The amplitude, or maximum difference from original soil temperature, of these variations will decrease rapidly with increasing distance from the cylinder as shown in Fig. 9, the curves being those calculated for soil of the assumed properties. It will thus be seen that for the case of cyclic withdrawal and return of heat, as contrasted with withdrawal only, separate cylinders may be located within short distances from each other, say 20 or 30 ft, without substantial interference.

Discussion

When the length of an isolated straight pipe is considered for withdrawal only of heat over a 20-year period on a schedule of *actual* requirement for normal heating, it is clear that the length would in any case be greater than that required for balanced yearly withdrawal and return of heat. It is estimated that the length would be 25 to 50 percent greater. A new estimate of 400 to 500 ft, depending on the pipe diameter, is therefore reached for pipe length for heat withdrawal without return. This is 2½ to 3 times the preliminary estimates of length based on heat withdrawal at a uniform rate. The corresponding

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factor in the case of a plate (or equivalent grid) is much smaller, being about 1¼ as noted previously.

A re-examination of the calculations relating to continuous withdrawal of heat at a plate surface, *Case 2*, is necessary to determine limitations in their practical application. It should be recalled that effects of heat exchange with atmosphere were excluded in those calculations, and hence the results apply strictly to the case of a deeply buried plate (or equivalent pipe-grid).

Such an arrangement would hardly be considered in practice, however, unless the extent of surface required would be less for deeply buried coils than for the more convenient shallow coils. It can be shown that, under selected operating conditions, with coils having relatively shallow ground cover, much or even most of the heat extracted by the coil would actually be drawn from the atmosphere rather than from the earth. The extent of such coils may be somewhat less than the 13,000 sq ft calculated for the conditions of *Case 2*. A consideration of shallow coils at various depths suggests, however, that not less than 6000 to 7000 sq ft of overall coil extent would be required to supply the heat requirements of the small house considered, if the minimum temperature at the evaporator is to be not lower than 15 to 20 F, as implicitly assumed in previous examples. The required surface would drop rapidly with a reduction in minimum permissible temperature at the evaporator.

It has been indicated that when the heat transfer surface is in the form of a plate (or equivalent planar coil) the surface required is only about one fourth as great for balanced heat extraction and return (*Case 3*) as for heat withdrawal only (*Case 2*). The relatively small surface for the cyclic case would, however, be realizable in practice only if heat interchange with the atmosphere were minimized. This would require that the heat transfer surface be located deep in the earth. The coil might, for example, take the form of a row of vertical pipes driven into the earth at sufficiently close intervals to act effectively as a plate.

While discussions of this paper have been concerned with the movement of heat through the soil by conduction only, consideration has been given to other possible factors affecting heat transfer. Such factors as thermal migration and convection of liquid water and diffusion of water vapor were considered in sufficient degree to suggest that conduction is the dominant factor in heat transfer, except in those special locations where there is a substantial gravity flow of ground water near the heat transfer surfaces.

Considering the generally favoring bias of the assumptions in this study, it is believed that in most cases ground coils would have to be as large as or larger than indicated. Since, however, even as estimated here, the extent of coil needed for the various cases is quite large from the standpoint of installation cost, it is doubted that ground coils will be an economic heat-source for *general* use. It appears, therefore, that as much attention as possible should be given to the study of means of minimizing the difficulties in the use of other sources, especially air.

Table of Symbols

θ = temperature change with respect to the original uniform earth temperature, degrees Fahrenheit, a variable with respect to time and distance.

θ_s = temperature change at the surface, degrees Fahrenheit.

θ_o = amplitude of temperature variation, degrees Fahrenheit.

k = mean thermal conductivity of soil, Btu per (square foot) (hour) (Fahrenheit degree per foot).

c_p = mean specific heat of soil, Btu per pound per degree Fahrenheit, a constant over the temperature range involved.

ρ = density of soil, pounds per cubic foot, a constant.

$\alpha = \frac{k}{\rho c_p}$ = thermal diffusivity of soil, square feet per hour, a constant.

q = rate of heat flow, Btu per (hour) (linear foot of cylinder).

A = imposed constant rate of heat flow at the cylindrical surface, Btu per (foot of axial length) (hour).

Q = rate of heat flow, Btu per (hour) (square foot of planar heat transfer surface).

B = imposed constant rate of heat flow at the planar surface, Btu per (square foot) (hour).

W = total heat, Btu per (season) (square foot of planar heat transfer surface).

W' = total heat, Btu per (season) (linear foot of heat transfer cylinder).

T = period of complete time cycle, hours (1 year = 8760 hours).

t = time, hours.

ω = angular velocity $= \frac{2\pi}{T}$, radians per hour.

ω' = angular velocity $= \frac{360}{T}$, degrees per hour.

a = radius of cylinder, feet.

r = radial distance from the axis of the cylinder to a point in the soil, feet, a variable.

x = distance perpendicular to the heat transfer surface, feet.

k = 0.896 $\quad \rho$ = 103

c_p = 0.45 $\quad \alpha$ = 0.0193

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THE SILICOSIS PROBLEM IN OHIO

By Lester M. Merritt*, Columbus, Ohio

Silicosis is a disease of the lungs peculiar to people who work in industries using a compound of silicon and oxygen known as silica, generally the mineral quartz. These industries include the foundries, most of the ceramic industries, the cut stone industry, those polishing, buffing and grinding steel, the coal mines, manufacturers of foundry supplies and a few other miscellaneous industries using silica in the manufacture of their products. The disease is also found among bricklayers who handle silica brick and fire brick in building the furnaces used in the steel and glass industries.

For many years men have died prematurely from the effect of silica dust in their lungs. The disease has been given many different names dependent upon the industry involved. In potteries it was called *potters' consumption* or *potters' rot*, in foundries it was known as *molders' consumption* and stonecutters have known it as *stonecutters' asthma* or *stonecutters' consumption* since so often the man died from the effects of tuberculosis.

Medical authorities have named it *silicosis* since the action of the minute silica particles causes the harmful effects. Only particles having a diameter of less than five microns can be inhaled. In fact many authorities consider that particles larger than three microns will not be taken into the lungs. The continued action of this mineral in the lungs replaces the normal breathing surface with scar tissue, causing breathing to become more difficult. In many cases tuberculosis sets in, hastening the death of the workman.

† Talk presented to the Central Ohio Chapter of the ASHVE, January 17, 1949.

* Division of Safety and Hygiene, Industrial Commission of Ohio.

Distribution of Silicosis Claims in Ohio Industries

During the period July 31, 1937, when silicosis became compensable in Ohio, to November 30, 1948, the Industrial Commission of Ohio allowed compensation to 1382 persons due to silicosis. Of these, 777 or 56.2 percent occurred in foundries: 179 in steel foundries, 446 in iron foundries and 152 in nonferrous foundries.

In addition to these, five people working for manufacturers of foundry supplies were allowed claims. Another 408 or 29.5 percent of the total occurred in the ceramic industries.

The cut stone industry has had 78 or 5.6 percent of the total. Of these, 52 worked in preparing monuments used in our parks and cemeteries, five worked in sandstone quarries and 21 in the preparation of sandstone for buildings and grinding wheels. Polishing, buffing and grinding operations, where either a highly siliceous material such as tripoli was used as a polishing or buffing medium, or a sandstone wheel was used for grinding metal, were accountable for 16 of the total. Coal mines had eight. A miscellaneous group of operations such as sandblasting buildings, sandblasting in industry and handling of silica flour in the manufacture of paint furnished 36. Although one would hardly expect a bricklayer to produce enough dust to contract silicosis, nevertheless, 50 bricklayers who worked in steel mills and four who worked in glass plants have been compensated.

Foundries

Free silica is brought into the foundry in several different ways. The first source is in the sand used in forming the molds and cores. This sand is approximately 80 percent free silica and 20 percent clay, with most of the silica quite coarse. A second source of free silica is the silica flour used in facings and in cores. This one is far more dangerous than the molding sand because the silica has been ground to a size which is readily respirable. A third source is in the form of parting compound. For many years the only dry parting available to foundrymen was made by coating tripoli, which is a free silica material formed by the rotting of sandstone with some fatty substance. Today, fortunately, very little tripoli parting is used in the foundry.

The two places in the foundry where the greatest volume of harmful dust is produced, are in the shakeout and cleaning room. Dust can be controlled at the shakeout through proper ventilation. If dust is either confined or exhausted in the cleaning room it can be reduced to an amount which will not be harmful to human beings. Wet methods of cleaning also reduce the amount of the dust getting into the atmosphere.

Ceramics

For the purpose of discussion in this paper, the general ceramic subject will be divided into whiteware, heavy clay products and a miscellaneous group of industries. The first of these include tableware, artware, sanitary ware, electric insulators and floor and wall tile. In this group the body is generally compounded of ball clay, china clay, feldspar and flint. Of these the flint is appromixately 99 percent free silica. The feldspar may vary from 5 to 20 percent free silica. These

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ingredients are purchased separately and compounded into the body before the ware is formed, dried, burned and glazed.

It is interesting to note that silicosis is more rampant among people who handle the compounded body used in the aforementioned industries, than among those who handle the silica in the manufacture of the heavy clay products where the silica is an impurity in the clay taken from a quarry or mine.

In the manufacture of building brick, fire brick, sewer pipe and the like, clay is taken from a quarry or mine, crushed through a roll or gyratory crusher and fed to a dry pan. If the clay is dry, the dust counts may show 100 to 500 million particles per cubic foot of air in the area of the dry pans and screens. Though this is far in excess of any dust counts taken in the whiteware industry, the people who work in these heavy clay products are not affected as badly with silicosis as those in the whiteware. Glass house refractory manufacture has produced an abnormal number of claims due to silica flour or flint which is added to the mix. This freshly ground silica seems to react quickly in the lungs.

One manufacturer who had produced hollow tile for many years and who had had dust counts ranging from 100 to 300 million particles in the grinding room, started to manufacture insulating brick in 1932. He used the clay gained in his own mine, along with a quantity of diatomaceous earth. This material was bloated to form a porous mass and burned in the kilns. He sawed these adobes to standard brick size with a carborundum wheel. Since he had no adverse experience with dust in his plant previously, he paid little attention to the dust produced in sawing.

He stopped the manufacture of these brick in 1938 after having produced them for a period of five years. To date 10 persons have been granted claims for silicosis resulting from that dust. This situation appears to the writer as an example of what may happen to human health if a manufacturer changes his product or process without studying its effect on a human being.

Another example of the same type occurred in the manufacture of a special filtering medium for bacteria. There the company used a mixture of diatomaceous earth and other ingredients which was pressed into a mold and burned. The product was then shaped on a lathe and drill press. In this situation, two men were granted claims for silicosis before the company decided to exhaust the sizing operation of their product.

Few people have had silicosis in the glass industry. Since the sand used in the manufacture of glass is mostly larger than 50 mesh, very little is respirable. Nevertheless the hazard is present unless proper control measures are taken.

In the manufacture of frits for enameling metal, there is a siliceous dust produced if a finely ground silica is used. The hazard is lessened considerably if 30 to 50 mesh sand is substituted.

Cut Stone

Ohio has quarries producing sandstone in Lorain, Tuscarawas, Washington and Scioto Counties. For many years the stone was drilled with dry drills prior to shooting. Today a flow of water passes through the drill, thus reducing the dust to a minimum. Exhaust equipment has been added to the saws and planers which finish the stone to the size used in the building trades or for grindstones, thus removing a greater portion of the dust. Men who have worked with pneumatic chisels carving sandstone have been affected by the silica. Most of these operations are exhausted today.

The stone used in monuments is generally granite which is approximately 60 percent feldspar and 40 percent quartz. It is only the quartz content of this stone which is harmful. For many years all of the carving and lettering of monuments of this type was done by hand or by pneumatic chisels. Today most of it is accomplished by sandblasting, using silica sand, artificial grit or metal shot as the eroding medium.

This work is done in enclosed rooms with the man operating the blast standing outside of the room. A suction of air is pulled past the man into the room and the dust produced inside the room is removed and collected in filtering units. The substitution of carborundum or alundum grit for silica sand reduces the amount of harmful dust produced inside the room, as the dust which is produced by the break-down of the sand is eliminated. Carborundum and alundum are not considered to be harmful to the lungs.

Polishing, Buffing and Grinding

When a tripoli material is used as part of the polishing or buffing compound there is some dust produced which is harmful. This has been shown by the diagnosis of silicosis in several people who have worked on this type of job. When steel is ground on a sandstone wheel, there is considerable dust produced at the point where the sandstone and steel meet. Even though there is a flow of water directly onto the wheel, the point of contact between the steel and the wheel is quite dry as indicated by the shower of sparks produced. Dust counts taken in the area have generally been higher 10 to 15 ft from the wheel than at the point where the operator stands.

Coal Mines

Eight people have been awarded silicosis claims caused by working in coal mines in Ohio. These have all been in cases where the roof and/or the floor is sandstone or a highly siliceous shale or clay, with the exception of one claim where the claimant had worked on the gathering locomotive. In this case the mine had a steep incline in the entry and a considerable amount of sand was used in a confined area for sanding the rails to prevent the locomotive from slipping when hauling a load. Information available at the present time indicates

that coal dust will not form a fibrotic condition in the lungs.

Bricklayers

The men who lay silica and refractory brick in steel mills and glass plants are exposed to dust, both in tearing out old structures preparatory to repairing and rebuilding, and in chipping, cutting or grinding the brick in laying. Silica brick is used for the roofs in open hearth furnaces and glass tanks. This material is 95 percent or more quartz, tridymite and cristobalite, which are all considered hazardous. Much of this dust can be eliminated if proper ventilation is furnished at the time repairs are made.

Miscellaneous

Several men who have done sandblasting on buildings have been allowed silicosis claims. This hazard is being relieved somewhat by wet blasting, which lowers the quantity of dust produced. Often companies having sandblasting operations at irregular intervals do not make proper provision for eliminating the dust, as they consider the hazard only temporary. They may furnish the employee with a respirator which he may or may not use. If this process is continued for some time the man may get silicosis.

Two men have been allowed claims in a cement plant. They worked in the raw grinding department. It was their job to grind the stone to pass approximately 200 mesh prior to clinkering. There was little attempt to collect the dust in that plant; one dust count taken at a place where a man worked showed 150 million particles of dust per cubic foot of air.

Two men were granted claims in a paint manufacturing plant. They dumped silica flour into a tank used to mix an asphaltic paint sold for painting smoke stacks.

Reducing Silica Hazard

The silica hazards of industry could be eliminated entirely if all materials containing crystalline silica were deleted. Practical considerations, however, do not permit this, as silica has many properties which are necessary in the production of items to which our civilization has accustomed us. Thus far no mineral has been found in sufficient quantities or at a price which will allow it to replace quartz in industry.

Since it does not seem practicable to eliminate silica entirely, the next step must be control by reducing the dust to nonhazardous quantities in places where men work. Control can be divided into three categories; 1. eliminate silica where possible; 2. confine the dust in spaces where men do not normally work; and, 3. remove the dust at the point where it is generated. Some silica has been eliminated by the substitution of non-silica partings for tripoli. Harmful dust can be reduced by eliminating silica flour in foundries. Dust can be confined by handling and storing siliceous materials in enclosed elevators, conveyors and bins. Dust can be removed at the source by exhausting the operation in which the dust is produced.

Good housekeeping efficiently practiced is an overall factor in reducing dust. If fine siliceous materials are allowed to accumulate on floors, dust will get into the air through air movement and traffic. Dust which has settled on rafters and other overheads will be shaken off by wind movement in the building, by extremely hard vibration of machinery or possibly by birds. This precipitates finely divided particles of sicila into the atmosphere. Vacuum cleaning devices may be efficiently used to remove dust from floors, tops of machinery and overheads.

Conclusion

Almost every industry in which silica sand is used provides silicosis hazards. If silicosis is to be eliminated as a hygienic hazard, industry must prevent the workman from coming in contact with particles of free silica which are small enough to pass through respiratory tracts into the lungs. While health authorities have set up standards of a maximum of 5 million particles of free silica per cubic foot of air, the experience of the Ohio Industrial Commission has shown that men will get silicosis when subjected to air containing less than that amount.

For that reason industry should strive to reduce the dust in their plants to the absolute minimum. Management must administer proper supervision over the plant and dust collecting equipment so as to know at all times the conditions in which the workmen live during their daily routine. Dust control safeguards the health of the workman and in this way helps to promote his efficiency and improve his morale.

1949 TAC's INCLUDE HEAT PUMP, ODORS

Heat Pump

Objective of the recently reorganized TAC on the Heat Pump is the study of heat sources in localities where both heating and cooling are required and where degree days range between 2000 and 5000. Proposed cooperative research projects will be considered by the committee, and other research will be suggested.

R. C. Jordan is chairman of the Technical Advisory Committee on the Heat Pump, and other members are: E. R. Ambrose, R. D. Blum, C. F. Boester, C. W. Brown, W. F. Friend, M. C. Giannini, J. D. Kroeker, E. P. Palmatier, and S. S. Sanford.

Odors

A Technical Advisory Committee on Odors has recently been formed with membership as follows: T. H. Urdahl, *chairman;* N. E. Berry, W. V. Consolazio, C. L. Fay, W. A. Grant, E. P. Heckel, G. W. Meek, H. T. Porter, and W. N. Witheridge.

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SEMI-ANNUAL MEETING
1949

COMMITTEE ON ARRANGEMENTS

J. E. Haines, *General Chairman*

L. C. Gross, *Vice Chairman*
F. B. Rowley, *Honorary Chairman*

Banquet—D. B. Anderson, *Chairman;* R. E. Backstrom, G. S. Bean, J. A. Craig, J. C. Davidson, William McNamara, C. P. Peterson, William Sturm.

Entertainment—J. S. Locke, *Chairman;* M. R. Eastin, S. L. Furber, Mrs. J. E. Haines, N. B. Herman, H. K. Knoblauch, L. J. Krause, J. A. Nichols.

Finance—C. T. Lawrence, *Chairman;* C. L. Benson, Guy M. Brown, C. O. Carlson, D. M. Forfar, H. K. Knoblauch, H. P. Roberts, F. H. Schernbeck.

Ladies—H. K. Johnson, *Chairman;* A. L. Cherne, Mrs. H. E. Gerrish, Mrs. H. K. Johnson, Mrs. J. S. Locke, Mr. and Mrs. A. W. Schultz, H. G. Sierk, H. D. Woolman.

Publicity—H. C. Mills, *Chairman;* J. R. Bergan, R. T. Haley, H. B. Williams.

Reception—A. B. Algren, *Chairman;* R. E. Backstrom, M. H. Bjerken, M. R. Eastin, H. E. Gerrish, W. H. Kliever, F. F. Lange, J. F. Stafford, W. R. Uhl, M. S. Wunderlich, R. T. Squire.

Sports—B. F. McLouth, *Chairman;* F. E. Bell, J. A. Craig, R. T. Haley, V. E. Nelson.

Transportation — G. M. Kendrick, *Chairman;* R. D. Albyn, J. K. Gerrish, J. G. Hamm, H. D. Woolman.

David B. Anderson
Chairman
Banquet

James S. Locke
Chairman
Entertainment

Hartzell C. Mills
Chairman
Publicity

Chester T. Lawrence
Chairman
Finance

G. Mitchell Kendrick
Chairman
Transportation

Technical Sessions and Social Functions Beckon Members to Minneapolis Meeting

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Nicollet Hotel—June 19-22—Minneapolis, Minn.

A TEMPTING program has been prepared for members attending the Semi-Annual Meeting 1949 at Minneapolis, and Minnesota members anticipate arrival of their fellow members on June 19. Prior to the official opening of the meeting, the Council and a number of committees will meet and there will be a series of technical committee meetings throughout the three-day sessions.

Physiological Reactions will be the theme of one session, and papers on Panel Heating and the Heat Pump will feature another session; the subject of Air Handling and Distribution will be the important topic of the third session.

The Program and Papers Committee has announced selection of papers on Human Tolerance Limits for Extreme Heat by W. V. Blockley and Craig H. Taylor; Earth as a Heat Source or Storage Medium for the Heat Pump, by E. W. Guernsey, P. L. Betz and N. H. Skau; Air Streams from Perforated Panels by Alfred Koestel, Phil Hermann, and G. L. Tuve; and Heat Gains Are Not Cooling Loads by C. O. Mackey and N. R. Gay.

Members will receive hotel reservation forms through the mails and a list of special events for which advance reservations are requested. There will be a special program for the ladies and children.

The principal events and meetings will be held at the Nicollet Hotel, which is located conveniently near all railroad stations, and within a few blocks of the city's shopping and entertainment district. The Minneapolis Tourist Information Bureau is directly across the street.

Sunday—June 19

Reception — Hotel Nicollet — 1:00 p.m. to 12 midnight

The Reception Committee, headed by Prof. A. B. Algren, will greet those who plan to arrive on Sunday, in the Minnesota Hospitality Room (Parlors J-K) at the Hotel Nicollet. This reception will be held all afternoon and evening—from 1 o'clock in the afternoon until midnight—to accommodate those who desire to meet friends, make reservations for the events of the meeting, or plan recreational and other activities. Light refreshments will be served.

Monday—June 20

Ladies' Luncheon and Card Party—12:15 p.m. to 5:00 p.m.

On Monday, the first day of the meeting, the ladies will have an opportunity to get acquainted—while their husbands are golfing—at the luncheon and card party which is scheduled for 12:15 p.m. in the Hotel Nicollet's beautiful Minnesota Terrace.

Men's Buffet Luncheon and Golf—12:30

Concurrent with the ladies' luncheon, there will be a Buffet Luncheon for the men at the Minneapolis Golf Club—followed by the Research Cup Match and the Eichberg Memorial Cup competition is for Chapter Teams of three players. The luncheon will be served in the club house. In the event of inclement weather, the matches will be held Tuesday or Wednesday.

Children's Tour of Minneapolis Parkways and Lakes—1:00 p.m. to 5:00 p.m.

The Children's Committee has prepared a fine afternoon program for the youngsters to occupy them while Mother and Dad are golfing and lunching. Competent drivers will take the children to the scenic lake area in and around Minneapolis, and on a conducted tour of the Museum of Natural History and the flour mill of General Mills, Inc. There will be no charge for this tour and it is suggested that those

Skyline of Minneapolis as seen from Loring Lake

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PROGRAM

Semi-Annual Meeting 1949

Sunday—June 19

10:00 a.m. Committee Meetings

1:00 p.m. REGISTRATION

1:00 p.m. Minnesota Chapter Hospitality Room Parlors J-K open until midnight

2:00 p.m. Council and Committee Meetings

Monday—June 20

8:00 a.m. Minnesota Chapter Hospitality Room

9:00 a.m. REGISTRATION

10:00 a.m. TECHNICAL SESSION—Grand Ballroom

Determining Performance of a Blower Used With a Furnace, by N. A. Buckley and R. W. Roose

Air Streams From Perforated Panels, by Alfred Koestel, Philip Hermann and G. L. Tuve

Pressure Loss and Air Flow Characteristics of a Box Plenum, by S. F. Gilman, R. J. Martin, W. R. Hedrick and S. Konzo

12:15 p.m. Ladies Luncheon and Card Party—Minnesota Terrace Room

12:30 p.m. Men's Buffet Luncheon

Golf Tournament—Research Cup and Eichberg Memorial Cup Matches, Minneapolis Golf Club

1:00 p.m. Children's Tour of Minneapolis Parkways, Lakes, Museum of Natural History, University of Minnesota, and flour mill of General Mills, Inc.

2:00 p.m. INSPECTION TRIPS—Choice of trips listed p. 129

2:00 p.m. Committee Meetings

6:00 p.m. Social Hour—Dinner—Smorgasbord—Entertainment and Dancing East Room and Grand Ballroom

Tuesday—June 21

8:00 a.m. Minnesota Chapter Hospitality Room

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION—Grand Ballroom

Earth as a Heat Source or Storage Medium for the Heat Pump, by E. W. Guernsey, P. L. Betz and N. H. Skau

Heat Pump Results in Equitable Building, by J. D. Kroeker, R. C. Chewning and C. E. Graham

Ground Temperatures as Affected by Weather Conditions, by A. B. Algren

10:00 a.m. Ladies Inspection of Betty Crocker's Kitchen

1:00 p.m. Golf

1:30 p.m. Automobile Tour of the City Lakes and Lake Minnetonka

1:30 p.m. Nominating Committee

2:00 p.m. Committee Meetings

6:30 p.m. Dinner—Reservations at selected eating places in Minneapolis

7:00 p.m. to 10:00 p.m. Launch Trips—Lakes Calhoun, Isles, and Cedar

8:00 p.m. Informal Party—Junior Ballroom

Wednesday—June 22

8:00 a.m. Minnesota Chapter Hospitality Room

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION—Grand Ballroom

Permeance Measurement Improved by Special Cell, by F. A. Joy and E. R. Queer

Human Tolerance Limits for Extreme Heat, by W. V. Blockley and Craig L. Taylor

Heat Gains Are Not Cooling Loads, by C. O. Mackey and N. R. Gay

Solar Energy Transmittance of 8-in. Hollow Glass Block, by G. V. Parmelee and W. W. Aubele

10:30 a.m. Ladies and Children—Radio Station KSTP

1:00 p.m. Children—Games and Swimming—Lake Nokomis

1:00 p.m. Golf

2:00 p.m. INSPECTION TRIPS—Same List as Monday p.m.

2:30 p.m. Committee Meetings

3:00 p.m. Ladies Style Show and Tea—Dayton's Sky Room

5:00 p.m. Social Hour—East Room

7:00 p.m. Banquet—Entertainment and Dancing—Grand Ballroom

Method of Choosing Location of, Financing and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.

2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, not exceeding $500.00, the regular meeting expense to be taken care of by the General Fund of the Society in the regular way.

3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.

4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.

5—That the grouping of features and the sale of tickets for group fentures be discouraged.

6—That the raising of funds from manufacturers of heating apparatus be discouraged.

7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.

8—That the distribution of trade papers be entirely at the discretion of the committee in charge.

9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., and that this General Committee be requested to confer frequently with the Council, through the Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.

10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1926.

members who plan to have their children accompany them to the meeting, make reservations by mail so that the Committee will be able to plan the transportation facilities.

Inspection Trips—2:00 p.m. to 4:00 p.m.

The following Twin City groups have offered to open their plants for inspection tours during the Meeting: University of Minnesota, General Mills, Inc., Minneapolis-Honeywell Regulator Co. (downtown plant), U. S. Air Conditioning Corp., McQuay, Inc., Bros Boiler and Mfg. Co.

The Transportation Committee will arrange for private cars for these tours. No tickets are required, but members are requested to register on Sunday or on Monday morning so that the necessary arrangements can be made in advance.

Social Hour, Dinner and Entertainment—6:00 p.m. to 12:30 a.m.

At the end of the first day's round of golfing, meetings, luncheons, and tours, all members and their families are invited to enjoy a very unusual event—a social hour followed by a Smorgasbord dinner, entertainment and dancing. Advance reservations are required.

Tuesday—June 21

Tour of Betty Crocker Kitchens at General Mills, Inc.—10:00 a.m. to 11:00 a.m.

Chances are, every woman attending the meeting has heard of Betty Crocker, General Mills' nationally known baking and cooking authority. The Ladies' Committee has made arrangements for a group of visitors to inspect the celebrated Betty Crocker Kitchen, Tuesday morning. We know we don't have to "sell" this event to the ladies. All we're going to say is, "Get your reservation in early!"

Golf (open)

Tuesday's golf schedule is contingent upon Monday's weather—which is another way of saying that if the Cup Matches are rained out on Monday, they will be held on Tuesday. If the matches come off on schedule (Monday), there will be open golf on Tuesday. Members will probably want to arrange foursomes ahead of time, and local members will make arrangements at the various clubs and courses.

Tour of the City Lakes and Lake Minnetonka—1:30 to 5:00 p.m.

The Minnesota Chapter has planned a scenic tour of the many lakes and parks dotting the Twin City area and Lake Minnetonka, which will provide entertainment for those who do not care to golf. Private cars, made available by members and local firms, will provide the transportation—without cost, of course. Minneapolis is unique among large cities in that it has many lakes and streams right in the heart of the city.

Dinner

Tuesday night's dinner will be on a non-scheduled, go-where-you-like basis. The Committee has arranged for reservations at most of the local eating places, many of which are well known to gourmets all over the country. You will want to specify your choice ahead of time to assure seating.

Launch trips—7:00 p.m. to 10:00 p.m.

Tuesday evening, some of those who have been busy with other activities will want to take advantage of an opportunity to see the Minneapolis lakes. For them, launch trips have been planned which will cover Lake Calhoun, picturesque Lake of the Isles, and Cedar Lake.

Informal Party—Junior Ballroom; 8:00 to midnight.

If the Lake trip does not tempt you or if you are a little foot sore after golf and inspections, Tuesday night will find the Junior Ballroom a pleasant place for a social evening.

Wednesday—June 22

Radio Program—Station KSTP—10:30 a.m. to 11:30 a.m.

The ladies and the youngsters will want to take in this event, an audience-participation show with genial Randy Merriman the M.C. Fun and lots of laughs. No fee, but you'll want to make your reservations to assure a seat.

Children's Beach Party—Lake Nokomis—1:00 p.m. to 5:00 p.m.

Let the kiddies enjoy themselves at the beach while you are making an inspection tour or golfing. The Entertainment Committee will see that they are well cared for and entertained all afternoon. Games, swimming and just plain playing on the shores of beautiful Lake Nokomis. Careful supervision and safe transportation are assured.

Golf—1:00 to 5:00 p.m.

Minneapolis Golf Club—or other selected clubs and courses—same schedule as Tuesday. Luncheons available, but not scheduled.

Inspection Tours—2:00 to 4:00 p.m.

(Same schedule as Monday)

Ladies' Style Show and Tea—Dayton's Sky Room—3:00 to 4:00 p.m.

This will be a high spot for the ladies. Dayton's new and beautiful Sky Room will provide the setting for an informal tea gathering which will feature a style show. Minneapolis' leading department store will appeal to "shoppers."

Grand Finale—Banquet

Preceded by a social hour (5 to 7:00 p.m.) in the East Room, the Banquet will be held at 7:00 p.m. This Banquet has been planned to provide a fun-packed climax for the meeting, and the Committee has gone to great lengths to assure that everyone has a wonderful time. There won't be speeches in the regular sense, but an entertaining master of ceremonies, radio comedian Bob DeHaven, will keep the diners happy with his special brand of rollicking patter. Dancing in the Ballroom will follow the dinner and entertainment. At this time, too, the golf trophies will be awarded. The price includes steak dinner and dancing.

The Semi-Annual Meeting offers the opportunity of participating in technical discussions of subjects of current interest and a vacation trip for the family in the Minnesota Lake Region.

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Summary of Local Chapter Meetings*

• **CENTRAL NEW YORK**—March 16, 1949. A symposium on automatic temperature controls and their application to heating, ventilating, and air conditioning systems was conducted at the meeting in Syracuse. R. A. Baker, Minneapolis-Honeywell Regulator Co., Minneapolis, and C. D. Cross, Johnson Service Co., Milwaukee, were the speakers.

Following the talks, many questions from the audience were answered by the speakers.

The treasurer's and chapter delegate's reports were made during the business portion of the meeting. Attendance 38. Attendance ratio 0.24.

• **CENTRAL OHIO**—February 21, 1949. Cooling towers were a $50,000,000 business last year, H. E. Degler, Kansas City, Kans., told Central Ohio Chapter members gathered in the Chittenden Hotel, Columbus. Speaking on *Water Cooling Towers for Refrigeration and Air Conditioning*, Mr. Degler described the economic design and application features of cooling towers, in construction and operation. The conservation of water was a point stressed by the speaker, who mentioned specific local problems and costs of water, as well as the methods for conserving the supply through the use of condensing steam plants, spray ponds and cooling towers.

Pres. W. M. Myler, Jr., reported on membership, and chapter participation on the ASHVE research program was also discussed. The speaker for the next meeting was announced as L. R. Craig, York Corp., Cincinnati, who would talk on *Low Temperature Applications at Wright Field*. Attendance 29.

• **CONNECTICUT**—March 24, 1949. Air diffusion as a science was the theme of the lecture and movie given by V. F. Self, Anemostat Corp. of America, New York City, before the Connecticut Chapter meeting in Bridgeport.

It was announced that the meeting in April was to be the Chapter's annual meeting, and that the May meeting would begin with an inspection trip followed by the dinner meeting.

Chapter delegate P. J. Lamoureux reported on the various events of the 55th Annual Meeting. Attendance 70. Attendance ratio 0.29.

• **DELTA**—March 8, 1949. The regular dinner meeting was held jointly with the New Orleans section of *ASRE* in New Orleans. Speaker of the evening was James M. Todd, consulting engineer, New Orleans, and president of the *ASME*. Mr. Todd spoke on cooperation among engineers in regard to activities of various engineering societies.

L. V. Cressy announced plans for a joint meeting to be held in the future with the Louisiana Engineering Society. Attendance 56. Attendance ratio 0.40.

• **DELTA**—February 8, 1949. During the regular meeting in New Orleans, a report by J. S. Burke, chapter delegate, described the events of the 55th Annual Meeting of the Society. Other business included a report on membership and discussion of plans for future chapter meetings.

Speaker of the evening was John Manion, district manager, Carrier Corp., Jackson, Miss. His talk was entitled *What Value Comfort*, and was followed by a movie tracing the history, development and varied applications of air conditioning. Attendance 37. Attendance ratio 0.45.

• **GOLDEN GATE**—March 3, 1949. Equipment, measuring devices, instruments, and a special air conditioned room for testing, were viewed by members on a tour of the experimental laboratory of the University of California, at Berkeley. Before the tour, Prof. N. W. Snyder spoke of the University research program which included cooling towers, measurement of heat flow and instrumentation for thermal radiation.

During the business meeting, the forthcoming visit of A. E. Stacey, Jr., president of the Society, was announced. A joint meeting with *ASME* and *AIA* was also announced with the speaker's subject to be *Reverse Cycle Refrigeration*.

Before the meeting, dinner was enjoyed in the Turquoise Room of the University of California cafeteria. Attendance 66.

• **ILLINOIS**—March 14, 1949. *Electricity—a Competitor for Space Heating*, as discussed by G. K. Marshall, refrigeration engineer in

* Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

charge of heat pump work, General Electric Co., and R. C. Cassidy, chief engineer, Uskon Heating Panel Div., United States Rubber Co., gave members and guests an insight into some of the current developments and focused attention on the fact that electric panel heating and reverse cycle refrigeration may offer serious competition to older established heating fuels.

Mr. Marshall cited Lord Kelvin's work, reviewed early industrial and European heat pump developments and applications, and showed slides of several types of installations.

He showed a number of curves indicating theoretical, actual, and possible (with improved equipment) coefficients of performance. Various sources of heat such as air, ground, and water were described. After showing an operating cost chart, he stated that the heat pump is only justified where year 'round conditioning is desired. He believes it will compete with other fuels on a cost basis where electricity is available at 2 cents per kwhr or less. Attendance 137.

• INDIANA—February 25, 1949. A joint meeting with the Purdue Student Branch was held in the Mechanical Engineering Building, Purdue University, W. Lafayette, Ind., and featured three speakers. W. G. Husted, student, speaking on *Wastewood for Fuel*, outlined the processes used in converting lumber wastes to a solid fuel, and compared the advantages and disadvantages of the fuel.

A. V. Anderson, Jr., also a student, gave a talk on the ventilation problems in the Purdue fieldhouse. Improper ventilation had caused moisture to form on the ceiling and rot the insulation, he said. The proper amount of ventilation needed to stop the moisture formation was determined by calculations.

J. I. Gonzales, an instructor in general engineering at Purdue, gave a resumé of the plan of study in the graduate school.

I. W. Cotton reported on the 55th Annual Meeting in Chicago, and C. H. Hagedon announced the following future meetings: March—*Study of Sound;* April—*Controls;* and May—*Radiant Heating*. Attendance 59.

• IOWA—March 14, 1949. Guests from Iowa State College were present at the chapter meeting in Des Moines which featured a talk by Pres. A. E. Stacey, Jr., Syracuse, N. Y. President Stacey outlined the establishment of the Society and its subsequent development to its present strength of 41 chapters and 8 student branches. The history of the ASHVE publications and the development of the Society's research were also discussed by President Stacey. He later showed some slides on process applications in different industries, where temperature and humidity changes affected product manufacture. Slides showing early research in the Society were also shown. Attendance 55. Attendance ratio 0.87.

• KANSAS CITY—March 7, 1949. At this meeting held in conjunction with the *ASRE* in Kansas City, Mo., plans for aiding the student branch at the University of Kansas Engineering Exposition this spring were announced. John Hilburn, president of the Boese-Hilburn Electric Co., made a short humorous talk on the *Profession of Living*.

H. C. Pierce, assistant manager, Air Cond. Div., Servel Inc., Evansville, Ind., described the principle of operation of a gas-burning air conditioner and compared commercial with residential air conditioning. Attendance 102.

• MANITOBA—March 17, 1949. At the March meeting held in Winnipeg a number of reports preceded the guest speaker and included greetings from the Ontario Chapter represented by A. J. Strain. Pres. J. R. Stephenson, presiding over the meeting, reviewed current activities of the Committee on the Promotion of Research, and D. F. Kenney, chapter delegate, reported on the 55th Annual Meeting of the Society. Guest speaker was F. L. Morton, chief engineer, McPhillips St. Pumping Station, Greater Winnipeg Water District, who described the use of water in air conditioning. Attendance 24. Attendance ratio 0.57.

• MASSACHUSETTS—February 15, 1949. Problems encountered by the U. S. Navy during World War II in shipboard heating and ventilating were described by T. H. Urdahl, consulting engineer, Washington, D. C., before members gathered at M. I. T. in Cambridge. In his talk entitled *Design Time Savers for Heating, Ventilating and Air Conditioning*, Mr. Urdahl stated that the assembling of a large engineering force from many sources and with varied design opinions necessitated standardization of procedures and simplification of methods. He showed slides of calculators used to compare duct sizes and coil selections.

The work being done by the Committee on Promotion of Research was outlined by John Bonner. Attendance 68. Attendance ratio 0.62.

• MINNESOTA—March 7, 1949. District heating and problems of air pollution were topics for discussion at the March meeting, in Minneapolis, which featured three speakers. J. T. Gallagher, director, Public Utilities, Piqua, Ohio, described the steam distribution begun in Piqua in 1945.

Roy Diehl, smoke inspector for the City of Cleveland, spoke on *Air Pollution*. Of 42 cities with populations of 200,000 or more, 38 have ordinances on air pollution, he said. He recommended that city committees for smoke abatement contain representatives of many organizations.

Walter Bartel, Ric-wiL Co., presented slides on the Cleveland smoke abatement campaign and also showed types of central heating in Cleveland and other cities throughout the country. Guests included the mayor of Minneapolis and Carl F. Boester, of ASHVE Council. Attendance 106.

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JOURNAL SECTION

• **MINNESOTA**—February 7, 1949. The use of glycol vapors to kill bacteria in the air was discussed by B. H. Jennings, Professor of Mechanical Engineering, Northwestern University, Evanston, Ill., and president of *ASRE*, at the meeting in Minneapolis.

Pres. O. L. Lilja reported on the chapter delegates' activities during the Annual Meeting in Chicago. He also announced the death of a member of the chapter, W. A. Weber. The program for March was outlined, and five members were elected to serve on the nominating committee. Attendance 63.

• **MONTREAL**—March 21, 1949. At the March meeting in Montreal, the new officers for the Montreal Chapter were announced as follows: S. W. Salter, *president;* R. R. Noyes, *vice president;* J. G. Chenevert, *secretary;* and T. G. Anglin, *treasurer*. The new *Board of Governors* is: Leo Garneau, *chairman;* R. S. Libby, B. J. Horsburgh, S. R. Plamondon, and F. G. Phipps.

P. L. Davidson gave a talk on *Textile Mill Air Conditioning*, which covered design and operating problems. Attendance 61.

• **MONTREAL**—February 21, 1949. *The Heat Pump and Its Use* was the subject of the talk given by E. P. Palmatier, research department, Carrier Corp., Syracuse, N. Y., at the February meeting in the Berkley Hotel, Montreal. A report of the chapter delegates' meeting in Chicago was made by Pres. Leo Garneau. An amendment to the chapter constitution was passed unanimously, providing for only one term as chapter president, except in cases of emergency. Attendance 62.

• **NEBRASKA**—March 8, 1949. The meeting was held in the Regis Hotel, Omaha, with J. W. May, director of research, American Air Filter Co., Louisville, Ky., speaking on *The Electrostatic Precipitator*. Mr. May discussed the history of electronics as it applied to air filtration and the latest trends in air cleaning. Slides were shown depicting the various methods of cleaning air and the application of these methods. Attendance 54.

• **NEW YORK**—March 21, 1949. A thought provoking talk was given by C. F. Neergaard, hospital consultant, who spoke on *Burning Up Hospital Money* at the Building Trades Employers Club, New York City.

The speaker stated that the subject really was *Burning Up Hospital Money*. He showed by means of tables the great discrepancy that exists in the sizing of heating and ventilating equipment for hospitals, particularly in regard to boiler capacity provided. He stated that the average Building Committee for a hospital spends less time in deciding to accept the mechanical equipment recommendations than it does in selecting the hardware to be used on the doors. Faults which Mr. Neergaard had observed in hospital planning were outlined, and the following were given particular attention: (1) Too little insulation in buildings; (2) too much radiation; (3) too many radiators; (4) excessive boiler capacity.

O. O. Oaks was announced as the N. Y. Chapter representative on the committee to advise the mayor on rules and regulations for the Smoke Abatement Commission of New York City.

An auditing committee was appointed, as follows: H. S. Birkett, Chairman, B. F. Thomas and Clifford Strock. Attendance 150. Attendance ratio 0.26.

• **NEW YORK**—February 21, 1949. The February meeting in the Building Trades Employers Club in New York City was movie night, with several films being shown. *Steam for Power* showed the development of boilers and combustion equipment from the earliest inventions to present day high pressure equipment. *Heating Research in Houses* depicted research in Great Britain, being conducted in housing projects incorporating various types of construction and heating appliances. Two other films of the entertainment type followed.

Business taken up at the meeting included an announcement by Pres. A. A. Bearman that the chapter's membership has now reached a total of 344. President Bearman also reported on the Society's 55th Annual Meeting. Attendance 125.

• **NORTH TEXAS**—February 21, 1949. Temperature control of air conditioning in railway passenger cars was discussed by John Haines, vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., at the February meeting held in Dallas. His talk was illustrated with slides and was followed by a question and answer period.

Visiting members of the Texas A. & M. Student Branch made several announcements pertaining to the college. A report on the 55th Annual Meeting in Chicago was given by Pres. G. A. Linskie. C. Rollins Gardner reported on progress of the plans for the 1950 Annual Meeting. Members who went to Chicago on the special train presented a gift to Mr. Gardner in appreciation of his services in arranging for the train. Attendance 111. Attendance ratio 0.58.

• **NORTHERN OHIO**—March 14, 1949. How railroad car heating, ventilating and air conditioning developed from the old stoves to the modern air conditioning of the streamliners was the theme of the talk given by J. S. Locke, Minneapolis-Honeywell Regulator Co., Minneapolis, before Northern Ohio Chapter members in the Engineering Society Bldg., Cleveland. He pointed out the advances made since the end of World War II in the general systems and in the controls. A large group of railroad men in the audience enlivened the discussion which followed.

Reports were given by the membership and entertainment committees. It was announced that the

speaker for April would be J. R. Vernon, Milwaukee, Wis., who would talk on current practices in automatic temperature control for heating and air conditioning. Attendance 73.

• **NORTHERN OHIO**—February 14, 1949. A round table discussion of *Heating Specialties* was carried on by J. A. Hall, N. W. Calvert and H. M. Nobis at the meeting of the Chapter in Cleveland. Mr. Hall discussed steam traps, Mr. Calvert spoke on the various types and applications of pressure reducing valves, and Mr. Nobis presented the consumer's viewpoint.

Lester T. Avery reported on a recent Council Meeting, at which several subjects pertaining to the Society were taken up, including Annual and Semi-Annual Meetings, the research program and Society membership.

It was announced that the speaker for the next meeting would be J. S. Locke, Minneapolis, Minn., who would describe advances in railroad heating, ventilating and air conditioning. Attendance 68.

• **OKLAHOMA**—March 14, 1949. At the meeting in Oklahoma City, the nation's largest heat pump, in the Equitable Building, Portland, Ore., was described by A. C. Menke of The Trane Co., LaCrosse, Wis. The 12-story building was designed by J. Donald Kroeker, consulting engineer and a member of the Council of the ASHVE. The structure is the first aluminum-clad building in the country, Mr. Menke said, as well as being the first completely air conditioned building in the Pacific Northwest. Attendance 33.

• **ONTARIO**—March 7, 1949. Dinner at the Royal York Hotel, Toronto, was followed by the regular monthly meeting at which the 55th Annual Meeting, building specifications, and other subjects were discussed.

Robert Dunn then introduced the speaker of the evening, E. E. Sparrow, chairman of the Workmen's Compensation Board of Ontario. Speaking on *Trends in Modern Personnel Relations*, Mr. Sparrow described the new problems of personnel in factory and office. Attendance 74. Attendance ratio 0.42.

• **OREGON**—March 3, 1949. New officers elected at the March meeting in Portland are as follows: J. P. McDermott, *president;* R. C. Chewning, *vice president;* A. C. Clark, *treasurer;* K. H. Hanson, *secretary*. New members on the Board of Governors are: K. N. Flocke and W. A. Simpson. R. C. Chewning was elected delegate and A. N. Hoss was elected alternate on the Chapter Delegates Committee.

Prof. Samuel Graf, head of the department of mechanical engineering, Oregon State College, spoke on *Why Industry Should Employ Mechanical Engineering Graduates*. Whether the engineering graduate should enter a large or small company is a problem, he said.

Walter Baker, associate professor in mechanical engineering, and superintendent of heating, Oregon State College, spoke on courses in heating and ventilating and on the use of equipment in the college experimental laboratory. The present interest in heat pumps and panel heating, Professor Baker said, indicated important possibilities for careers for graduates.

J. F. Culbertson, graduate assistant in research, presented a summary of an Oregon State College bulletin entitled *Reverse Cycle Heating*.

Guests at the meeting included 9 students of the engineering department of Oregon State College. Attendance 130. Attendance ratio 0.48.

• **PACIFIC NORTHWEST**—March 23, 1949. A historical survey of the Society, its publications and research highlighted a talk before the Chapter in Seattle, given by ASHVE Pres. A. E. Stacey, Jr., Syracuse, N. Y. Mr. Stacey brought out many interesting facts. He said that the first chapter (Illinois) was formed in 1906 and pointed out that the first edition of THE GUIDE contained about 200 pages as contrasted with its present thousand. Mr. Stacey also showed some slides of the cotton, wool and other industries with their rigid requirements of humidity control.

Programs for the April and May meetings were announced by J. D. Sparks. The May meeting, he said, would be held at the Boeing Aircraft Co. plant. Attendance 47.

• **PHILADELPHIA**—March 10, 1949. *Forced Hot Water Heating* was the subject of the talk given by Harold A. Lockhart, Bell & Gossett Co., Morton Grove, Ill., at the Engineers' Club. Pres. J. O. Kirkbride presided, and John McElgin, Program Committee Chairman, introduced the speaker who gave a detailed explanation of the fundamentals of hot water heating and piping. Mr. Lockhart gave some interesting results of his researches in this field of heating by means of forced circulation of hot water.

A report of the Chapter's financial condition was given by Treasurer E. K. Wagner and the minutes of the Board of Governors were read for the members' information. A brief statement on current activities of the Society was given by Sec'y. A. V. Hutchinson.

• **PITTSBURGH**—March 14, 1949. The value of air conditioning in bettering industrial morale, production and attitudes was emphasized by B. B. Reilly, at the meeting in Pittsburgh. Mr. Reilly, manager, air conditioning section, Dravo Corp., Pittsburgh, spoke on *Social Aspects of Air Conditioning in Industry*.

A movie shown by Mr. Reilly traced the development of air conditioning from its origin to its present trend. He described conditions in the heavy industries, plants and mills. An example was that of crane cabs over pickling beds and near furnaces in steel mills. Air condi-

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tioning in these cabs, said Mr. Reilly, enabled crane operators to work in comfort.

He said that the engineer needs a progressive approach to the problems of industrial ventilation and the education of management in the values of air conditioning.

Committee reports were given by the following: R. J. Doherty, attendance; E. C. Hach, membership; and C. H. Schneider, chapter delegate at the 55th Annual Meeting. Attendance 36.

• **ROCKY MOUNTAIN**—February 3, 1949. Types of apparatus used to collect dust particles were described by R. B. Foley in his talk to the chapter in Denver, Colo. Mr. Foley, supervisor of dust collector research, American Blower Corp., Detroit, stated that the study of dust particle actions involves several variables.

Two methods are used in the experimental study of dust particle motion—*sedimentation* and *elutriation*. *Sedimentation* is that process in which the particles are observed as they fall in air or other fluid. *Elutriation* is that process in which the particles are suspended in a moving stream of air or other fluid, the velocity of which may be adjusted to the terminal velocity of the particles under study. The sizes of dust particles are measured in microns, one micron being one-millionth of a meter. Mr. Foley demonstrated the effect of size, shape and density on terminal velocity by means of an electric blower discharging upward through a transparent plastic cone in which the air velocity decreased with height. A golf ball, a tennis ball and wood blocks of various sizes and shapes assumed positions in the cone in accordance with their various terminal velocities.

Dusts may be classified according to their effects upon people or processes. For example, silica and asbestos dusts are harmful, since they cause silicosis when breathed into the lungs. Combustible or explosive dusts such as organic, plastic or metallic dusts created by process industries or fly ash containing unburned carbon are collected for their intrinsic value. Most dusts are a nuisance and are collected in order to avoid their dispersal into the atmosphere. Smoke and fly ash are examples of nuisance dusts.

Pres. Fred Janssen reported on his trip as chapter delegate to the 55th Annual Meeting in Chicago. Attendance 39. Attendance ratio 0.57.

• **ST. LOUIS**—March 3, 1949. The March meeting was held jointly with the Engineers Club of St. Louis and the St. Louis Chapter of *ASRE*. Prof. G. L. Tuve, Cleveland, Ohio, past president of the ASHVE, was guest speaker. His subject was *Air Conditioning in 1960* and centered around the control of energy, maintenance and air. Professor Tuve illustrated his remarks with slides showing air distribution through grilles and slots. Attendance 340.

• **SHREVEPORT**—March 17, 1949. A color film *Steam for Power* was the feature at the meeting which followed dinner in the Caddo Hotel, Shreveport, La. Announcement was made concerning the Fifth Annual Air Conditioning Conference to be held at the A. & M. College of Texas, College Station, Tex., March 25-30, 1949.

It was decided that a picnic would be held in place of the regular June meeting. Robin Hood read a financial report and also gave a brief talk on the Louisiana Polytechnic Institute, Ruston, La.

• **SOUTH TEXAS**—February 18, 1949. A report on activities of chapter delegates at the 55th Annual Meeting in Chicago was made by R. J. Salinger before the Chapter members assembled in the Rice Hotel, Houston. C. P. Howard, of the Texas A. & M. Student Branch, spoke briefly, inviting the South Texas Chapter to the A. & M. Open House to be held on May 7. Karl Martino spoke for the Texas University Student Branch which was to have its charter meeting in March.

Advancements and improvements in heating and ventilating railway passenger cars were described by John E. Haines of the Minneapolis-Honeywell Regulator Co., Minneapolis. A. F. Barnes reported on the Engineers' Council of Houston and the Symposium to be held on April 2.

Bert P. Fisher was appointed head of a placement committee to assist students from the University of Texas, Texas A. & M., University of Houston, and Rice Institute. Attendance 79. Attendance ratio 0.27.

• **SOUTHERN CALIFORNIA**—March 16, 1949. Possibilities of utilizing ultrasonic radiation in the elimination of industrial smokes and fumes were discussed by H. C. Murphy at the Chapter meeting in Beverly Hills. Mr. Murphy, a consulting engineer, Carmel, Calif., outlined the difficulties of successful smoke abatement in Los Angeles as compared with other cities confronted with the same problem. Attendance 52.

• **SOUTHERN CALIFORNIA**—February 16, 1949. At Eaton's Restaurant, Beverly Hills, Pres. R. S. Farr reported on the Society's Annual Meeting which he attended as a delegate.

J. S. Locke, Minneapolis-Honeywell Regulator Co., Minneapolis, spoke on *Advances in Railway Car Heating, Ventilation and Air Conditioning*. Some of the problems of railway cars, said Mr. Locke, are difficulties of distribution; the wide range of design conditions; and the sudden and frequent load changes. Attendance 72.

• **UTAH**—February 14, 1949. The engineer and his relation to the public was discussed by Fred Thomas, president of the *Utah Society of Professional Engineers* and chairman of the Utah Engineering Council before the Utah Chapter, Salt Lake City. Mr. Thomas also re-

ported on the activities of the Engineering Council.

A second speaker was J. S. Locke, Minneapolis - Honeywell Regulator Co., Minneapolis. Mr. Locke spoke on *Heating and Ventilating of Railway Cars*. R. H. East, chapter delegate, reported on the 55th Annual Meeting in Chicago and brought out certain points pertaining to activities of the chapters. Attendance 42. Attendance ratio 0.38.

• VIRGINIA—March 16, 1949. At the meeting in Norfolk, the use of refrigerants in air conditioning was the topic of R. L. Williams, Kinetic Chemicals, Inc., Wilmington, Del. He discussed uses of many refrigerants and gave demonstrations of them.

Announcement was made that Lester T. Avery, Cleveland, O., first vice president of the ASHVE and president of Avery Engineering Co., would appear on April 11 to speak on *Air for Healthful Living*. Attendance 25. Attendance ratio 0.28.

• VIRGINIA—February 9, 1949. The heat pump in the Los Angeles area was the subject of a paper written by Al Hanson and read at the meeting in Norfolk by T. L. McLaughlin, both of the Drayer-Hanson Corp. The paper *Heat Pump and Its Application* is presented in abstract as follows:

A minimum outside air temperature of 35 F and the lack of water available for heat pump use make the air to air system preferable. This paper gave basic design data and many formulas useful in the design of the heat pump installations. It pointed out that air movement helps prevent the undesirable slime on the cooled product and also, on air temperature of about 38 F, will prevent coil frosting, thereby increasing the efficiency and decreasing maintenance of the equipment.

A discussion following the presentation of the paper led the group to the conclusion that an air to air system would be impracticable in Norfolk, Va., where temperatures often fall below freezing during the heat season. Discussion brought out that in many residences the heating load is double the cooling load and this tends to rule out the heat pump as an economical installation. Most heat pump installations go into industrial buildings and stores where auxiliary heat sources offset this difference in heating and cooling load. Attendance 65. Attendance ratio 0.47.

• WESTERN NEW YORK—February 21, 1949. The New York State Institute of Applied Arts and Sciences, Buffalo, was the scene of a dinner and joint meeting with Institute students and Western New York Chapter members. A welcome of ASHVE members was given by Richard Dry, director of the Institute. A panel discussion was held, with members of the Society answering questions asked by students from the floor. Members of the panel were: W. R. Heath, moderator; S. M. Quackenbush, Nelson Hopkins, J. H. Bryce, M. C. Beman, G. E. Adema and Dean Mohn of the University of Buffalo. F. J. Weber handled the Society's part in the arrangements for this meeting. Attendance 59.

• WISCONSIN—February 21, 1949. At the monthly meeting in Milwaukee a resolution expressing sympathy was voted by the chapter on hearing of the death of a fellow member, M. V. Eicholtz. The secretary was instructed to transmit a copy of the resolution to Mrs. Eicholtz.

Speaker of the evening was A. C. Menke of the Trane Co., La Crosse, Wis. His subject was *The Nation's Largest Heat Pump* and dealt with the installation in the Equitable Building, Portland, Ore. Mr. Menke reviewed the basic principles of the heat pump cycle. He illustrated his talk with slides and diagrams of the building arrangement and flow diagrams for the heating and cooling cycles.

It was announced that the March meeting would be held in conjunction with the *ASRE* and the *ESM*; the April meeting is scheduled to be held in Madison. Attendance 41. Attendance ratio 0.28.

Student Branches

▲ NORTH CAROLINA STATE COLLEGE—March 29, 1949. The meeting was attended by many guests and prospective members, who were addressed by the Student Branch officers. This meeting, held at North Carolina State College, Raleigh, was the culmination of an intensive membership drive that the student branch has been making for the past month. Professor Doolittle, who is teaching heating and air conditioning at the college, gave the history of the ASHVE and the Society's contributions to the engineering profession.

Professor Hanson, head of the mechanical engineering department at the college, spoke on the advantages and obligations of membership in ASHVE, and outlined the new curriculum leading to a B.S. in heating and air conditioning which the department of mechanical engineering is to offer next year.

A committee was appointed to honor Prof. L. L. Vaughan at a banquet to be held soon. Attendance 66. Attendance ratio 0.66.

▲ NORTH CAROLINA STATE COLLEGE—February 22, 1949. An address on opportunities in the heating and air conditioning industry highlighted the joint dinner and meeting of the North Carolina Chapter and the North Carolina State College Student Branch on the College campus, Raleigh. The speaker, R. B. Crosland, Jr., secretary of the Chapter, gave student members timely and pertinent remarks on the employment prospects in their chosen field. Attendance 30. Attendance ratio 0.61.

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JOURNAL SECTION

▲ **PURDUE UNIVERSITY**—March 9, 1949. The most important factor to consider in heating is the human body, I. W. Cotton told the Student Branch in his talk, *New Ideas of Human Comfort*. Mr. Cotton explained how the human body is automatically cooled by the evaporation of moisture from the skin and how the comfort of the body depends on the rate of evaporation. He said that less air movement in a house added to comfort. This low air movement could be accomplished by having a greater heating surface at a lower temperature. He also stated that it would be best to kill all the cold at its source rather than to heat cold air as is commonly done.

Business matters included a report on membership by C. H. Sallman and announcements about the placement committee and the William Batt Award for engineers. Attendance 33. Attendance ratio 0.34.

▲ **PURDUE UNIVERSITY** — February 25, 1949 (see Indiana report on meeting in this issue).

▲ **TEXAS A. & M.**—March 10, 1949. Guests at the meeting on the A & M College campus, College Station, were C. C. Quin, D. M. Mills, and B. P. Fisher of the South Texas Chapter, Houston. Mr. Fisher spoke on *Modern Gas Fired Furnaces*, discussing the principles of combustion, metals and heat, operation and control. Following his talk, a general discussion period brought up additional interesting information about installation and operation of the heating system.

Short talks were also given by the other two members from the South Texas Chapter. Attendance 39. Attendance ratio 0.57.

▲ **TEXAS A. & M.**—February 2[illegible] 1949. The Air Conditioning Conference to be held at Texas A. & M. on March 28-30 was discussed, and the student branch made plans to participate in welcoming conference members. C. V. Brown read a letter from the University of Texas Student Branch, inviting the A. & M. Student Branch to attend their charter meeting on March 11.

The annual Engineers' Day to be held May 7-8 was discussed. A committee was appointed to make arrangements for the equipment to be demonstrated. A committee was appointed to aid students in summer and permanent placement. Attendance 27. Attendance ratio 0.42.

SOUTHWEST CONFERENCE FEATURES TECHNICAL TALKS AND WINNING ESSAY

Prominent members of four ASHVE Chapters participated in the 5th Annual Southwest Air Conditioning Conference at College Station, Tex., from March 28-30, 1949, and a prize-winning student essay on air conditioning was presented.

On Monday, March 28, the Conference opened with an address of welcome given by Dean H. W. Barlow, Texas A. & M. College. Opening remarks were made by Dr. F. E. Giesecke, New Braunfels, Tex., who is a past president of the ASHVE.

Winner of an essay contest sponsored by the Conference is C. P. Howard, a student in mechanical engineering at Texas A. & M. College and former secretary of the ASHVE Student Branch there. Mr. Howard's paper was judged the best, on the subject, *Why I Chose Air Conditioning Engineering as a Profession*.

Besides the opening meeting, there were six other sessions, including a night session on Monday and a reception given by the Texas A. & M.

C. P. Howard

Student Branch. During the three days, talks were give by the following, many of whom are ASHVE members: R. V. Berry, East Orange, N. J.; William Evans, Shreveport, La.; E. J. Stern, Dallas; D. B. Knudson, Austin; C. E. Blome, Dallas; R. B. Collier, Houston; J. F. Schwegmann, Dallas; E. E. Rothe and M. J. Shoemaker, Racine, Wis.; J. W. May, Louisville, Ky.; J. Donald Kroeker, Portland, Ore.; Prof. S. Konzo, University of Illinois, Urbana, Ill.; C. S. Cave, Dayton, Ohio; F. C. Brandt, Houston; and J. W. Spiselman, Newark, N. J.

The talks covered a wide range, with discussions on such topics as odors, insulation, air cleaning, heat pump, air distribution, electronic controls, and public school ventilation.

Banquet speaker was J. R. Hertzler, York, Pa. who spoke on *Past, Present and Future of Air Conditioning*. Prof. C. W. Crawford, head of the mechanical engineering department at Texas A. & M., acted as toastmaster.

At a luncheon given on Wednesday the speaker was Charles Blum, Houston.

Chairman of the several sessions were: D. M. Mills, Houston; W. E. FitzGerald, Shreveport; Marvin Brown, Dallas; A. J. Rummel, San Antonio; and B. P. Fisher, Houston. Two students, C. V. Brown, president of Texas A. & M. Student Branch, and Karl Martino, president of the University of Texas Student Branch, also acted as chairmen.

The 5th Annual Air Conditioning Conference was held through the cooperation of the Texas A. & M. College, the three Texas Chapters, the University of Texas Student Branch, the Shreveport Chapter of the ASHVE, and the air conditioning and related industries of Texas.

LATEST EDITION OF GUIDE IS LARGEST

THE 27th edition of the HEATING VENTILATING AIR CONDITIONING GUIDE, distribution of which to ASHVE members was completed in April, contains the largest technical data section (992 pages) ever published to date.

The 52 chapters of THE GUIDE are grouped in sections having the following headings: Principles, Human Reaction to Atmospheric Environment, Heating and Cooling Loads, Combustion and Consumption of Fuels, Heating Systems and Equipment, Air Conditioning, Special Applications and Installation and Testing Codes. Through the cooperation of more than 40 members and other authorities, all chapters of the previous edition were reviewed, and improvements made wherever current engineering practice or recent published data indicated progress or change in presentation of any subject.

Some of the special features of the 1949 edition are reviewed briefly in following paragraphs.

The theory and mathematical background for fluid flow computations in the chapter on Fluid Flow, have been enlarged upon, and a section has been added on Variable Flow Meters.

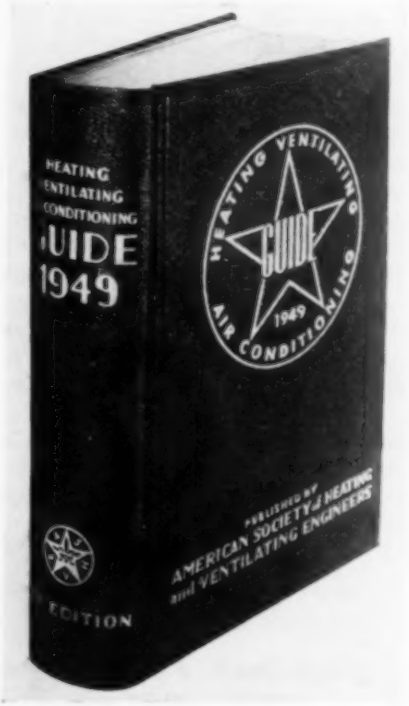
In the chapter on Heat Transmission Coefficients of Building Materials, the section on Vapor Transmission has been enlarged, and the method of computing the overall heat transmission coefficients of walls having high conductivity members has been expanded and improved. Federal specifications for water-proofed building papers have been added.

Permissible limits of air contaminants have been brought up to date with current practice, and are given in the chapter on Air Contaminants.

Under the subject of Instruments and Measurements, descriptions and comments on use of several additional instruments have been included. The chapter has been extensively revised and portions have been rewritten to clarify principles of operation and to indicate the precision of various measurements.

In the chapter on Physiological Principles, revisions have been made in sections relating to human reactions to extremes of hot and cold environments. The changes made have brought the data on these effects up to date with most recent research, and also with findings of the Armed Services.

Climatic data for both winter and summer have been improved by



addition of much new temperature data obtained from the U. S. Weather Bureau. In the chapter on Cooling Load, the calculation of solar heat gain through walls and roofs has been simplified by means of tables providing equivalent temperature differentials which can be used with tabulated heat transfer coefficients of the structure to obtain the heat transfer resulting from solar radiation, as well as air temperature difference. Convenient correction factors permit the user to apply the data to conditions other than those tabulated.

The section on Vaporizing Oil Burners has been enlarged in the chapter, Automatic Fuel Burning Equipment, and tables and data on sizing of gas piping have been added.

A new section on Space Heaters, Their Design, Rating, Installation and Operation, has been added to the chapter on Heating Boilers, Furnaces, Space Heaters.

Simplified methods of designing warm air systems, both for gravity and forced circulation systems, are outlined, and illustrate the use of the design methods recommended by the *National Warm Air Heating and Air Conditioning Association*. Special treatment is given, in the chapter on Mechanical Warm Air Systems, to the design of systems in buildings having a heat loss between 120,000 and 350,000 Btu per hour and also for systems having a greater loss.

The chapter on Steam Heating Systems and Piping has been improved by the addition of descriptions and illustrations of the various types of steam traps. Many new piping diagrams showing connections to heating coils have been included.

In the chapter on Spray Apparatus, the entire sections dealing with cooling towers and spray ponds have been rewritten to include descriptions of current equipment and design information for its application. Factors affecting location, selection and performance of cooling towers are given. Illustrations of various types of cooling towers are included.

In the revised chapter on Refrigeration, particular attention is given to application of refrigeration equipment. A new section on the heat pump, and revised tables for sizing of refrigerant piping have been added.

ASHVE research is the source of new tables giving circular equivalents of rectangular ducts in the chapter on Air Duct Design. The treatment of losses occurring in duct systems has been enlarged upon, and special consideration is given to losses caused by area

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changes. Three methods of sizing ducts are outlined, and design examples are given.

Numerous revisions in fundamental design data have been added to the chapter on Industrial Exhaust Systems.

Problems in drying have been amplified in the chapter on Drying Systems, and an example is given in the solution of a typical drying problem, and the selection of a belt-type of dryer. New illustrations of dryers and new diagrams of drying operations have been added.

The design and control of heating, cooling and air conditioning systems in modern railway passenger cars, street cars, trolley cars, passenger buses and aircraft, have been brought up to date with current practice, and modern trends in these rapidly changing applications are discussed.

The record of Codes and Standards applicable to Heating, Ventilating and Air Conditioning practice has been enlarged to include 115 which are of importance to the practicing engineer in this field. The list of Codes provides information on the latest available edition of each Code, together with the address of the organization from which each Code may be obtained.

A complete cross-index provides ready reference to the information in the Technical Data Section.

The 1949 edition of THE GUIDE was prepared under the supervision of the ASHVE Guide Publication Committee composed of: R. C. Cross, *Chairman*, A. B. Algren, R. L. Byers, R. P. Cook, Nathaniel Glickman, B. H. Jennings, H. R. Limbacher, W. M. Wallace, II, W. N. Witheridge, Cyril Tasker, *Ex-Officio*, and C. H. Flink, *Technical Secretary*.

A special feature of THE GUIDE is the Catalog Data Section which provides concise information on the up-to-date products of 249 manufacturers. A cross-index for this section provides quick reference to sources of supply for equipment needed in heating, ventilating and air conditioning installations. Available equipment is listed under a variety of headings in the cross-index in order to give the designer comprehensive lists of manufacturers and suppliers of any desired type of equipment.

In a total of 1384 pages, the 27th Edition of THE GUIDE contains 992 pages of technical data, and 392 pages of equipment data.

The external appearance of the Guide is in conformity with previous editions. The size is 6 x 9 in. and the book is bound in a blue cloth cover stamped in gold. The price of THE GUIDE is $7.50.

F. PAUL ANDERSON COMMITTEE APPOINTED

The engineer or scientist who receives the F. Paul Anderson Medal for outstanding work in heating, ventilating or air conditioning, will be selected by a committee of five distinguished members of the Society, one of whom has been a recipient of the F. Paul Anderson Award.

Formation of the F. Paul Anderson Award Committee has been announced by A. E. Stacey, Jr., president of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. The committee personnel consists of Lester T. Avery, Cleveland, *Chairman;* Homer Addams, New York City, Dr. F. E. Giesecke, New Braunfels, Tex., S. R. Lewis, Chicago, and H. C. Murphy, Carmel, Calif.

Lester T. Avery, first vice president of the ASHVE, is a native of Ohio. Graduating from Case Institute of Technology, he became an air conditioning and refrigeration engineer, and since 1929 has headed his own organization, the Avery Engineering Co.

Homer Addams is the only living Charter Member of the ASHVE, having been a member in its first year of existence—1894. He has been prominent in Society affairs ever since, serving as treasurer from 1915-22, as president in 1924, and as a member of Council for 10 years. In business life, he is chairman of

Nominations Invited

The **F. Paul Anderson Award Committee** desires to name an outstanding and worthy candidate for the Award, and therefore invites ASHVE members to help choose such a candidate. Nominations for the 1949 Award should be submitted in the following manner:

1. The **F. Paul Anderson Medal** shall be awarded to a member of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in recognition of notable scientific achievement or outstanding services performed in the field of heating, ventilating or air conditioning. There shall be no restriction on account of nationality or sex.
2. Include full information describing nominee's scientific achievements and tell why you think the nominee deserves the Award.
3. Nominations should be postmarked not later than **July 1, 1949.**
4. Mail nominations to:

Secretary

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

51 Madison Avenue

NEW YORK 10, N. Y.

JOURNAL SECTION

F. Paul Anderson Award Committee

Homer Addams
New York, N. Y.

Lester T. Avery
Cleveland, Ohio
Chairman

Dr. F. E. Giesecke
New Braunfels, Tex.

S. R. Lewis
Chicago, Ill.

H. C. Murphy
Carmel, Calif.

the board of directors of the Fitzgibbons Boiler Co.

Dr. F. E. Giesecke has himself received the F. Paul Anderson Award. In 1942 he received the medal for his research work in heat transfer and hot water heating. Dr. Giesecke is also a past president of the ASHVE, and is the author of several technical books. He is a professor emeritus at A. & M. College of Texas. Before his retirement in 1938 he was director of the Engineering Experiment Station at A. & M. He is active as a consulting engineer, specializing in heating and ventilating.

S. R. Lewis has been a consulting engineer for many years, specializing in schools and public buildings. A past president of the ASHVE, he has served on many committees, including chairmanship of the Society's Committee on Research.

H. C. Murphy, an engineer since 1910, has been a designer of arms for the U. S. Government and a specialist in air filtration. He is now a consulting engineer in Monterey, Calif., and has been active in the ASHVE for 25 years.

The newly appointed committee will invite ASHVE members to submit nominations for the award from among the membership. After studying these nominations, the F. Paul Anderson Award Committee will make its recommendation some time in October, at which time the ASHVE Council will make its choice, reserving the power, however, to decline to make any award for any year if no worthy recipient is nominated.

The F. Paul Anderson Medal was created in 1930 by the late Thornton Lewis, Philadelphia, and is awarded to ASHVE members in recognition of notable scientific achievement or outstanding services performed in the field of heating, ventilating or air conditioning. Since 1932, medals have been awarded to seven Society members as follows: W. H. Carrier, chairman of the board, Carrier Corp., Syracuse, N. Y.; Dr. A. C. Willard, president-emeritus of the University of Illinois, Urbana, Ill.; Prof. F. B. Rowley, director, Engineering Experiment Station, University of Minnesota, Minneapolis, Minn.; Dr. F. E. Giesecke, New Braunfels, Tex.; the late F. C. Houghten, Pittsburgh, Pa.; A. E. Stacey, Jr., Syracuse, N. Y.; and the late J. H. Walker, Detroit, Mich.

PRES. STACEY GUEST SPEAKER AT 6TH OREGON STATE CONFERENCE

Addressing the banquet which climaxed the 6th Oregon State Air Conditioning Conference of March 24, 25, and 26 at Corvallis, ASHVE Pres. A. E. Stacey, Jr., emphasized the need for research and education in engineering for human comfort. President Stacey also spoke at a technical session earlier in the Conference on *Was the Caveman Better Off Than We Are.*

The banquet came at the close of the second day of the three day conference sponsored jointly by the Department of Mechanical Engineering, Oregon State College, Corvallis, and the Oregon Chapter of the Society. Technical sessions were highlighted by the speech of John W. James, former technical secretary of ASHVE and now chief research engineer, McDonnell and Miller, Inc., Chicago. Mr. James said that health, comfort, safety, convenience and economy were primary concerns to users of heating, ventilating and air conditioning installations.

Also active at the Conference were Carl F. Boester and J. Donald Kroeker, both members of the ASHVE Council. Mr. Boester gave a talk and demonstration of residential panel heating and Mr. Kroeker was chairman of the Friday afternoon session which centered around *indoor climate*, the engineer's term for adequate air conditioning.

Alfred E. Stacey, Jr.,
President of ASHVE
Speaker at Conference
Banquet

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JOURNAL SECTION

Members and guests who attended the 6th OSC Air Conditioning Conference

Some of the subjects covered in talks by Society members were: *Railroad Car Air Conditioning* by J. S. Locke, Minneapolis-Honeywell Regulator Co., Minneapolis; *Insulation* by Paul D. Close of Simpson Industries, Seattle; *Oil Burner Nozzles and Combustion* by E. O. Olson, Delavan Engineering Co., Des Moines, Iowa; and *Refrigeration as Applied to Air Conditioning*, by R. H. Phillips, Carrier Corp., Los Angeles.

Presiding over some of the technical sessions were Bert W. Farnes, Farnes and Martig, Inc., Portland; and W. C. Baker, associate professor of mechanical engineering, Oregon State College. Toastmaster at the banquet was J. P. McDermott, The Trane Co., Portland, and music was provided by Music Master Arthur H. Bohren, Bohren Plumbing Service and Supply Co., Portland.

W. Bruce Morrison, a past president of the Chapter, presided over the installation of the 1949-50 officers who are: J. P. McDermott, *president;* R. C. Chewning, *vice president;* A. C. Clark, *treasurer;* K. H. Hanson, *secretary;* Board of governors: K. N. Flocke and W. A. Simpson.

Earl C. Willey, professor of general engineering, Oregon State College, spoke on the 1949 Conference, and E. R. Lokey, retiring chapter president reviewed accomplishments of the Oregon Chapter in the past year.

SOCIETY MEMBERS ATTEND ENGINEERING EDUCATION COUNCIL

Prof. Carl Kayan, Columbia University, and Prof. M. C. Giannini, College of the City of New York, were ASHVE delegates for Pres. A. E. Stacey, Jr., at the recent meeting of the Engineers' Council for Professional Development, held on March 21 at the Engineers' Club in New York. Also attending the meeting as a member of the Program Committee Conference was Walter L. Fleisher, past president of the ASHVE.

The purpose of the meeting was the discussion of possible ways to improve engineering education efficiency.

CCNY STUDENT BRANCH HOLDS CHARTER MEETING

A contingent of New York Chapter members including A. A. Bearman, Chapter President, and W. H. Driscoll, a past president of ASHVE, attended the charter meeting of the new student branch at the College of the City of New York, New York City, March 16.

W. H. Driscoll

Welcoming the students into the Society, Mr. Driscoll said that heating, ventilating, and air conditioning offered the young engineer a career of satisfaction. Mr. Driscoll traced also the growth of the Society since 1904, when it had only 200 members, and gave the students an amusing account of his first job as engineer when radiation was calculated by rule of thumb.

A. A. Bearman, president of New York Chapter, presented record

C. F. Boester at the Oregon State Conference

Pres. A. S. Stacey, Jr., Syracuse, N. Y., John W. James, Chicago and J. Donald Kroeker, Portland, Ore.

JOURNAL SECTION

books and spoke briefly about the Society. Other talks were given by Prof. Carl Kayan, Columbia University, and A. V. Hutchinson, ASHVE secretary. Faculty adviser

C. F. Kayan

of the student branch, Prof. Arthur Repetto, also spoke.

Officers of the new student branch at CCNY are as follows: Irving Kleinman, *president;* M. F. Shakun, *vice president;* W. R. Spencer, *corresponding secretary;* Douglas Dengeles, *recording secretary;* and M. H. Segner, *treasurer.*

UNIVERSITY OF KANSAS FORMS STUDENT BRANCH

Thirty members of the new University of Kansas Student Branch received greetings from the Kansas City Chapter at the charter meet-

D. M. Allen

ing and banquet held March 23 at the University in Lawrence. C. F. Boester, ASHVE Council member and guest speaker of the evening, told the students that successful engineering requires a spirit of inquiry, progressiveness and initiative.

D. M. Allen, also a member of ASHVE Council, presented the charter. Congratulatory letters and telegrams from the Society were read before the group.

Officers of the Student Branch are: Vance Elder, *president;* J. L. Williams, *vice president;* L. H. Noll, *secretary-treasurer.*

A few days before the charter presentation, the student branch held its first meeting, attended also by 11 members of the Kansas City Chapter of the Society and by faculty adviser Prof. H. L. Daasch, head of the department of mechanical engineering, University of Kansas. At the first meeting, H. A. Atwaters, chief engineer, Combustion Equipment Co., Kansas City, spoke on features of natural gas burning.

John Bowen receives the charter from President Stacey

OREGON STATE STUDENTS RECEIVE CHARTER FROM PRES. STACEY

During the banquet at the Sixth Oregon State Air Conditioning Conference at Corvallis, Pres. A. E. Stacey Jr. presented the charter to the new Oregon State College Student Branch. Accepting the charter, John Bowen, president of the student branch, spoke for his group in thanking Prof. W. C. Baker and E. C. Willey, whose efforts culminated in the formation of the OSC student branch.

In the charter presentation President Stacey was assisted by Professor Baker and by R. T. Mudge of the Oregon Chapter. Records for the student branch were presented by J. Donald Kroeker, ASHVE Council member.

NEW DETROIT BRANCH GIVEN CHARTER BY AVERY

Lester T. Avery, vice president of ASHVE, made the presentation of the charter to the University of Detroit Student Branch, at a dinner held in Detroit on March 14. Mr. Avery also spoke briefly about the Society, emphasizing its activities regarding student branches. The charter was accepted by Joseph B. Olivieri, president of the student branch.

Pres. A. E. Stacey, Jr., with a group of the Oregon Chapter and the Oregon State College Student Branch

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Vice Pres. Lester T. Avery presents University of Detroit student charter to Joseph B. Olivieri

Development of the University of Detroit Student Branch was described by Prof. George B. Uicker of the college of engineering. The student branch charter meeting was held in conjunction with the regular monthly meeting of the Michigan Chapter.

Officers of the new student branch of the University of Detroit are: J. B. Olivieri; James W. Van Loon, *vice president;* Arthur F. Lewis, *secretary treasurer;* and Stanley H. Kosinski, *reporter*. The student branch has 29 charter members.

STUDENT BRANCH ORGANIZED AT UNIVERSITY OF TEXAS

Receiving its charter from Dr. F. E. Giesecke, a past president of ASHVE, the new University of Texas Student Branch was officially welcomed by visiting Society members at a dinner in the Driskill Hotel, Austin, Texas, March 11, 1949.

Eighty-seven students and guests heard Karl Martino, president of the new branch, introduce the other officers: Daniel Belvin, vice president; and D. P. Collins, secretary. Faculty sponsor of the branch, Prof. Wayne E. Long, was also introduced.

Following his presentation of the charter, Dr. Giesecke spoke on the history, accomplishments, aims and possible future attainments of the Society. ASHVE Council members C. R. Gardner and Reg F. Taylor also spoke briefly, and Mr. Taylor presented the record books to the student branch officers.

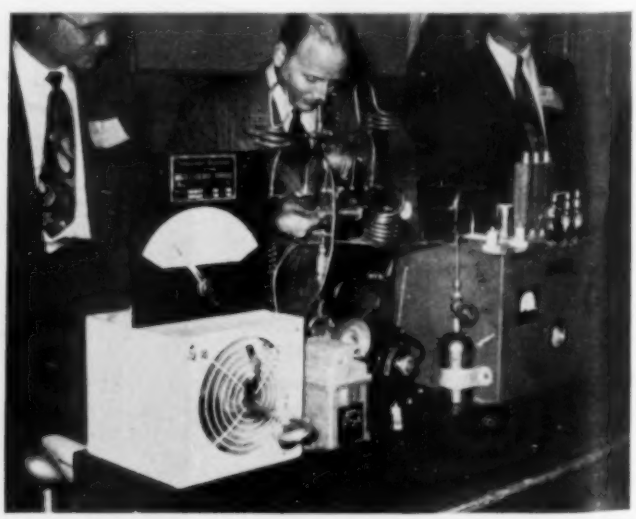
D. M. Mills introduced Hollis L. DeVines, or "Dr. Atom," the scientific member of the South Texas Chapter. For the next hour "Dr. Atom" kept the audience in suspense between scientific incredulity and atomic bewilderment with his discussion and demonstration of "Little Atom Jr.", the atomic air conditioner.

"Little Atom Jr." begins conditioning the air

Although "Dr." DeVines carefully explained the use of the atomic pile in the air conditioners he demonstrated, the results from "Little Atom Jr." left the audience mystified as well as amused.

A social program with music completed the evening.

From left to right, Karl A. Martino, Dr. F. E. Giesecke, Prof. Wayne E. Long, D. S. Belvin, R. F. Taylor and D. P. Collins



"Dr." DeVines gets the atomic air conditioner ready for operation

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 211 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by May 25, 1949, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ANDERSON, R. C., Sales Engr., Bryant Gas Heating Co., Cincinnati, Ohio. PROPOSERS: A. W. Edwards, H. A. Pillen. SECONDERS: Vincent Hotze, A. H. Gerdsen.

APONTE, RENE, Vice Pres., Standard Refrigeration Co., Inc., Santurce, Puerto Rico. PROPOSERS: Prof. Glenn Radcliffe*, Prof. Alice Parrott*. SECONDERS: R. R. Cobian*, F. R. Diaz*.

BAKER, J. H., Sales Engr., The Trane Co., Baltimore, Md. PROPOSERS: E. L. Crosby, W. G. Robertson, Jr. SECONDERS: H. D. Glaser, L. S. MacGann.

BALCOM, G. H., Sales Engr., Asbestos Supply Co. of Spokane, Spokane, Wash. PROPOSERS: E. C. Connell, E. W. Bunnell. SECONDERS: W. C. Vrandenberg, H. S. Jennings.

BATCHELOR, W. L., Lab'y. Asst., Tuttle & Bailey, Inc., New Britain, Conn. PROPOSERS: R. D. Tutt, Leonard Zavorski. SECONDERS: R. M. Strickland*, M. L. Bladessori*.

BERMAN, ALVIN, Supt., Alert Plumbing & Heating Co., Inc., Chicago, Ill. PROPOSERS: G. W. Bornquist, F. W. Thompson. SECONDERS: C. A. Pickett, E. W. Mautner.

BERRY, R. C., Sales Engr., McDonnell & Miller, Inc., Boston, Mass. PROPOSERS: P. H. Devlin, N. W. Swanson. SECONDERS: George LaRoi, J. W. James.

BHATTACHARYA, S. K., Air Cond. Engr., Ministry of Works, Mines & Power, Government of India, New-Delhi, India. PROPOSERS: J. M. Brown, S. R. Sarkar. SECONDERS: B. B. Ghosh, N. V. Bechir.

BONILLA, J. M., Engr., Equipos Mecanicos de Guatemala, Guatemala City, C. A. PROPOSERS: W. H. Wetherell, Albert Giannini. SECONDERS: Prof. C. F. Kayan, C. Craumer.

BORGOS, E. F., Air Cond. Engr., National Broadcasting Co., New York, N. Y. PROPOSERS: R. L. Stinard, Bernard Leventhal. SECONDERS: P. C. Hutchins, W. S. Bondy.

BOURQUIN, P. A., Jr. Engr., Wolff & Munier, Inc., New York, N. Y. PROPOSERS: L. L. Munier, P. B. Gordon. SECONDERS: R. A. Wolff, C. S. Koehler.

CENGIZ, NIHAT, Mgr. Air Cond. Dept., Hill Electric Co., Inc., Wichita, Kans. PROPOSERS: R. F. Bauer, O. P. Bullock*. SECONDERS: Dean T. M. Marshal*, L. N. Barlow*.

COLLINS, N. R., JR., Sales Engr., J. R. Dowdell & Co., Dallas, Tex. PROPOSERS: R. A. Mixon, J. R. Dowdell. SECONDERS: G. A. Linskie, R. G. Lyford.

CRONKHITE, E. G., Foreman, Purdy Mansell Co., Ltd., Toronto, Ont., Canada. PROPOSERS: W. R. Blackhall, William Philip. SECONDERS: M. C. Bailey, Ernest Fox.

DAVIS, P. G., Vice Pres., Sec'y. & Treas., C. W. Davis & Son, Inc., Huntington, W. Va. PROPOSERS: C. W. Davis, Prof. Merl Baker. SECONDERS: E. B. Penrod, L. O. Johnson.

DIETER, G. M., Dist. Mgr., Minneapolis-Honeywell Regulator Co., Spokane, Wash. PROPOSERS: W. C. Vradenburg, E. W. Bunnell. SECONDERS: E. C. Connell, H. S. Jennings.

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R. C. Champlin has been appointed general manager of the J. L. Gillen Co., Dowagiac, Mich., manufacturers of automatic gas and oil heating equipment. Mr. Champlin was formerly with the Richmond Radiator Co., Detroit.

Formation of the Don E. Hawk Associates, Inc., New York, N. Y., as manufacturers agents, has been announced by Arnold Croohe, vice president and a member of ASHVE. Officers are Don E. Hawk, president, R. A. Rankel, assistant treasurer, and L. D. Carr, secretary, all of whom were formerly associated with the William W. Short Co., Inc.

L. E. Pelletier, Newton, Conn., recently established a manufacturer's agency to cover the four states of Connecticut, western Massachusetts, Rhode Island, and Vermont.

Sidney A. Whitt, elected vice president of engineering for Cordley & Hayes, New York, N. Y., will direct development, design, and applications engineering for water cooling and allied fields.

R. A. Wilson has been appointed Columbus, Ohio, representative of Warren Webster & Co., Camden, N. J.

SMOKE PREVENTION GROUP TO MEET IN SOUTH

Four Society members will participate in the air pollution conference to be held from May 23 to 27, 1949 in Birmingham, Ala. The meeting is the 42nd Annual Conference given by the *Smoke Prevention Association of America, Inc.*

Taking part in the panel discussion of *A Model for Smoke and Dust Regulation Laws* will be: H. F. Hebley, Pittsburgh, speaking on *Rules and Regulations;* T. C. Cheasley, Kansas City, Mo., discussing *Permits, Installations and Operations,* and R. L. Wolf, Indianapolis, Ind., speaking on *Standards of Dust Measurement.*

The smokeless stove of the University of Illinois will be described by Prof. J. R. Fellows, department of mechanical engineering, University of Illinois, Urbana. Among other reports to be given are talks on the heat pump, medical aspects of air pollution, locomotive smoke abatement, the solid fuels industry, hot gases from high stacks, and air pollution in the steel industry.

An inspection trip will be made to the site of an underground gasification experiment at Gorgas, Ala. on May 27. Information about the conference may be obtained from Charles W. Gruber, Dept. of Safety, Bureau of Smoke Inspection, City of Cincinnati, 411 Lincoln Park Drive, Cincinnati 3, Ohio.

OBITUARIES

M. V. Eicholtz—The Society has been informed of the death of M. V. Eicholtz of Wauwatosa, Wis. Mr. Eicholtz was 60 years old.

At the time of his death, Mr. Eicholtz was district manager for Ilg Electric Ventilating Co. at Milwaukee, a position he had held for many years. Prior to his appointment in the Milwaukee office in 1920, he was district manager at St. Louis for four years.

His early experience included association with the Bloomfield Light, Power and Water Works at Bloomfield, Mo. He had been a member of ASHVE since 1942 and belonged to the Wisconsin Chapter.

W. R. Etie—Word has been received from the South Texas Chapter of the death of W. R. Etie, of Houston, who had been an ASHVE member since 1943.

Mr. Etie has been in the heating, ventilating, and air conditioning fields for many years. A native of Texas, he was born in Galveston in 1888, and owned and managed his own business in Houston. There he was engaged in constructing heating and air conditioning duct work. He was an active member of the South Texas Chapter.

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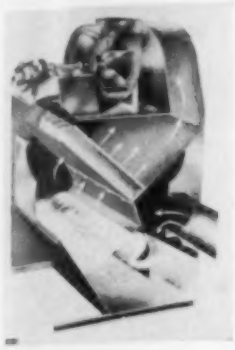
Redesigns Hydrostatic Dust Collector for Wide Range Use



No. 4029—The type N "Roto-Clone," used for the collection and control of dust generated in manufacturing and process operations, has been redesigned to permit wider application and improved performance. Developed in 1942 by American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky., it is a hydrostatic precipitator designed to clean air by the combined action of centrifugal force and intermixing of water and dust laden air, re-using the water without recirculation pumps or spray nozzles.

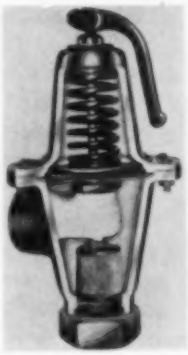
According to the company, the new Design 2 unit, with capacities thru 48,000 cfm, maintains a lower pressure drop with the same cleaning efficiency and water recirculation rate and can be operated from 50 to 120 percent of its nominal rating without affecting its collecting efficiency. All sizes are available in either the manual clean-out, sludge ejector, or hopper bottom arrangement.

Indicates Smoke Density and Controls Overfire Air

No. 4030—The smoke density indicator and control announced by General Electric Co., Control Divisions, Schenectady 5, N. Y., consists of a light source, a phototube holder, and an enclosure containing a control and incorporating an indicator calibrated in Ringlemann units. If desired a recorder, either of the continuous strip chart type or the circular "step" type, can be furnished.

In operation, a magnetic relay is set to operate when smoke density reaches some predetermined level, such as 35 percent, at which time a blower forces overfire heated air to the firebox until the smoke density drops to approximately 15 percent. Should the smoke density again rise, the relay is immediately energized and each time the relay operates an alarm is sounded to warn the boiler operator to adjust the draft in order to insure more complete fuel combustion. A chart type recorder may be used in conjunction with this equipment to provide a continuous record of smoke density. It can also be used as a measure of general operating efficiency as well as a proof of smoke ordinance compliance.

Monel Valve Seat and Disc Used in Safety Relief Valve



No. 4031—The No. 300 combination safety and relief valve is constructed in accordance with the present ASME code and is rated at a capacity of 318,000 Btu per hr. It is manufactured by Bell & Gossett Co., Morton Grove, Ill., and features the use of ground and polished monel for the valve seat and disc.

The design is said to assure the valve being wide open with an increase of only a few ounces above that required to open the valve. At low flow it discharges about 10 gph of water. When wide open and with 30 psi at the inlet, it will discharge 7 gpm. With an inlet pressure of 33 psi, it is said to discharge 11¼ gpm.

The arrangement of the strainer is designed to permit the valve to operate even though the strainer itself becomes filled with refuse. The basket is built like a relief valve disc and will lift and pass water should the mesh become filled.

Voltage Relay Used in Starting New Single Phase Motor

No. 4032—A new line of integral horsepower, single phase motors, now in production at the plant of Louis Allis Co., Milwaukee 7, features the use of a voltage relay for disconnecting the starting condensers from the line after the motor is up to speed.

The relay is mounted in the control cabinet furnished with the motor, as are the across-the-line starter and the necessary capacitors. According to the company, it is advantageous to mount these component parts away from the heat and vibrations of the motor.

Units are built in capacitor start-induction run types in ratings of 1 and 1½ hp. Capacitor start-capacitor run types are available in ratings of 2, 3, 5, 7½, and 10 hp.

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4039	4040	4041	4042	4043	4044	4045	4046	4047	4048
4049	4050	4051	4052	4053	4054				
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Name ..... Title.....

Company .....

Address .....

City..... ..... Zone..... State.....

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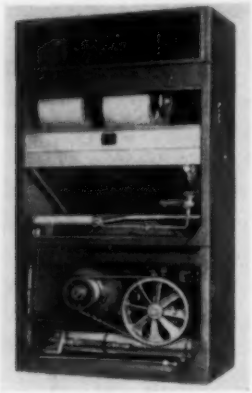
Packaged Conditioner Has Two Part Cabinet



No. 4033—The introduction of a new self contained, 10 ton air conditioning unit by Typhoon Air Conditioning Co., Inc., Brooklyn, N. Y., supplements the present range of 1½, 2, 3, 5 and 7½ ton units.

A free standing conditioner, its overall dimensions are 27 in. deep x 52 in. wide x 93 in. high. A two part cabinet is said to make it possible for the upper half to be placed in the conditioned area with the high side at a remote point. Features include accessibility of parts, low speed operation, and an insulated cabinet. The capacity is 125,000 Btu/hr at 36 deg suction temperature and 105 deg condensing temperature.

Other features are said to include an all-copper condenser, silver soldered throughout and adaptable for city water or water tower application, and an all-copper finned cooling coil.

Strengthens Multiple Sheet Aluminum Insulation

No. 4034—"Infra Accordion" insulation, a multiple sheet aluminum insulation with a fiber separating partition, has been strengthened in its construction, according to Infra Insulation, Inc., 10 Murray St., New York 7.

The two aluminum sheets now come to the edges of the flanges of the insulation so that when the material is stapled in place the staples pierce the two layers of aluminum as well as the one of fiber. This, says the company, eliminates any separation, insures the compartmentation of the insulation, and provides an additional reflective air space. In addition, the suspension of the two aluminum sheets is said to be assured.

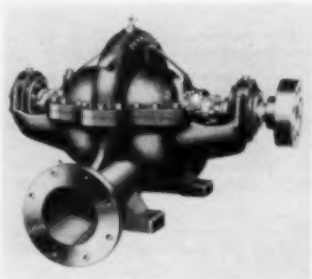
Condensate Return Unit Requires Little Space

No. 4035 — The "Space-Miser" condensate return unit, type SM, has three sides blank so that it can be placed in any corner and is designed to require relatively small space. It is available from American Hydrovac, Inc., 290 Scholes St., Brooklyn 6, N. Y., and is said to have a wide range of application.

The close coupled pump and motor are mounted on a cast iron receiver of 11 gal capacity. The pump impeller is of bronze and is of the enclosed type. Other features include a built-in basket type bronze strainer and a brass pipe (with ball check valve at its lower end) fitted to the pump inlet so that the pump is always primed. A check valve between the pump discharge and boiler is not recommended.

The unit is rated at 500 to 8000 sq ft EDR and the pump capacity is 12 gpm at 20 psi discharge. The maximum float switch setting is 7 gal between stop and start.

Single Stage Centrifugal Pumps Feature Horizontal Split Design



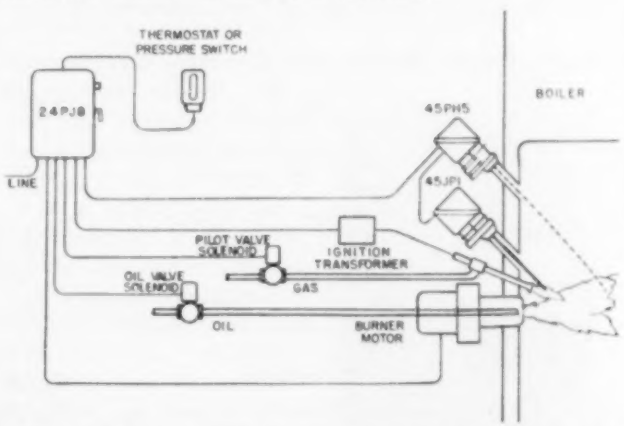
No. 4036—Said to be characterized by a wide capacity range up to 60,000 gpm at heads up to 300 ft, an augmented line of horizontal centrifugal pumps for general purpose pumping of water and alkaline fluids at temperatures up to 300 F, is available from Peerless Pump Div., Food Machinery and Chemical Corp., Los Angeles 31.

Units are of single stage, double suction, split case design and are available in sizes from 1¼ through 48 in. All types of drives may be employed.

The case is split at the centerline of the shaft so that the upper case and rotating element may be inspected or removed without disturbing pump alignment or piping connections. The upper half of the case is provided with water seal pipe to the stuffing boxes, air vents, and lifting eyes. Generally, all impellers are of enclosed double suction design, normally furnished in bronze but available in cast iron, stainless steel, monel, or other alloys.

Photoelectric Control Supervises Oil Burner Flame and Gas Pilot

No. 4037—To give protection against explosion caused by flame failure in industrial oil burner installations, Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., has devised a system for supervising both the pilot gas flame and the main oil flame.



The equipment consists of an electronic flame rod, type 45JP1, a photoelectric scanner, type 45PH5, and a programming control, type 24PJ8. If the pilot flame has not come on or is unsuitable for proper ignition, the flame rod signals this condition to the programming control and the burner shuts down before the main oil valve has even opened. With proper ignition, the main oil valve opens and the oil flame is then monitored by the scanner which contains both the phototube and amplifier tube. The photoelectric system is designed to withstand conditions of relatively high ambient temperature and is said to be impervious to ambient humidity.

The programming control is designed to provide accurate setting of both oil valve delay and post ignition periods. Timing is accomplished through a synchronous motor.

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Airfoil

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Compare these unbeatable low cost
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12 x 6 - - $3.40
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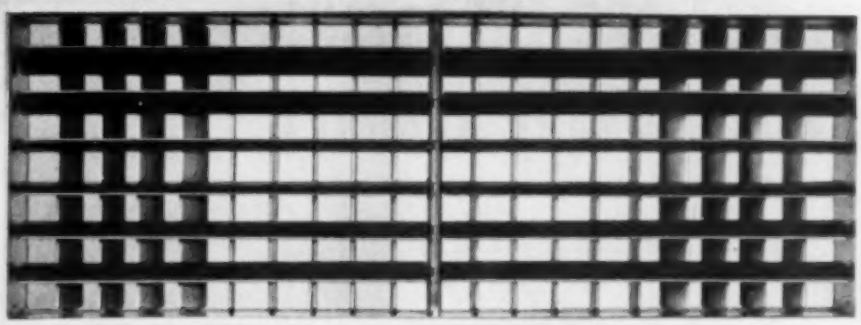

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The new Titus Airfoil No. 270 has been time tested and proven after years of research. It also features the Airfoil louvre with streamlined, smooth-as-glass, surface, which knifes the air and gives more control than heretofore thought possible.

This amazing new Titus Airfoil No. 270 grille does everything the more expensive grilles do *and Does Them Better!*

BEFORE YOU BID YOUR NEXT JOB, SEND FOR COMPLETE INFORMATION ON THE TITUS AIRFOIL No. 270. You'll be amazed at all the performance features which are incorporated in this grille. They mean so much — YET COST SO LITTLE.

NOTE THESE SPECIAL FEATURES

which give the Titus Airfoil No. 270 unapproachable air diffusion performance

- **Airfoil louvre — designed after the Airfoil section of an airplane.**
- **Solid section louvre construction for noise-free performance.**
- **Streamlined louvre with no sharp corners, no holes, no crevices.**
- **One-piece, extra-heavy frame.**
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- **Two banks of louvres.**
- **Individual blade adjustment.**

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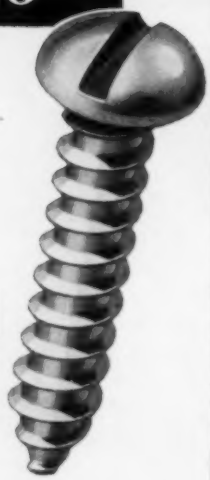

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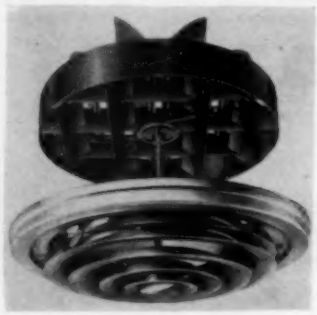
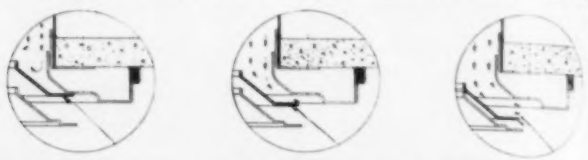
TAPPING SCREWS • STOVE BOLTS • PIPE PLUGS

Auxiliary Ring Controls Diffuser Air Delivery



No. 4038—Tuttle & Bailey, Inc., New Britain, Conn., has added a new ceiling diffuser to its "Aerofuse" line. Said to feature effective area control, the new type EAC unit is fitted with an adjustable auxiliary ring for on-the-job control of air delivery.

Manually operated by means of a lever, the control ring slides on an inclined plane and is raised or lowered to vary the effective area of the outer passage of the diffuser. Spring loaded clips are used to hold the ring in any desired position. In the



CONTROL RING FULLY CLOSED CONTROL RING HALF OPENED CONTROL RING FULLY OPEN

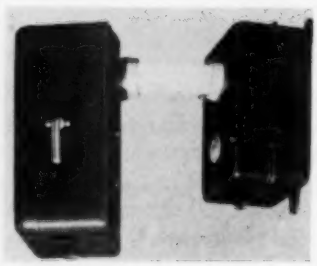
fully closed position, says the company, the ring completely seals off the outer air passage, reducing the effective area of the diffuser by approximately 40 percent.

Navy Type Dehumidifier Adapted to Commercial, Industrial Uses

No. 4039—Originally developed for the U. S. Navy, the model J-150 dehumidifying machine is a dual adsorbent type unit employing activated alumina as the drying agent and is entirely automatic. Adapted to commercial and industrial uses and now in quantity production, it is recommended for use where extremely low dew points must be maintained. The manufacturer is Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh 30.

The cycle may be adjusted for various conditions both in the drying and reactivation process. Steam, gas, or electricity may be used to provide the reactivation heat. Removal capacity is said to be 700 lb of water per day from air at 90 F dry bulb and 75 F wet bulb.

Photoelectric Cell Indicates Smoke Density in Flue, Breeching



No. 4040—Consisting basically of a photoelectric control and a light source mounted on opposite sides of a flue or breeching, the type A20C-1 smoke indicator has been developed to indicate when the density approaches the values prescribed by municipal smoke ordinances. The manufacturer is Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass.

A sensitivity adjustment permits the unit to be set for various smoke densities. Supplementary equipment also available includes bell alarms, densimeters (to give continuous indications), and recorders.

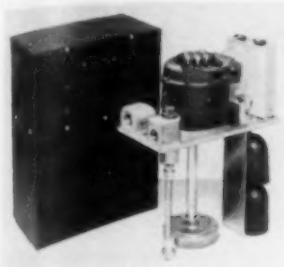
Said to be rugged in design, reliable in performance, and easily installed, this unit is recommended for average sized plants.

Prefabricates Radiant Panel Heating Coils

No. 4041*—R. E. Tompkins, Inc., 409 Wilder Bldg., Rochester 4, N. Y., is now prefabricating radiant panel heating coils.

The company will fabricate and, where desired, design complete coils or return bends only and can also supply air eliminators, coil take-offs, and other components. According to the firm, an ingenious method is used for collapsing and shipping the welded and tested coils.

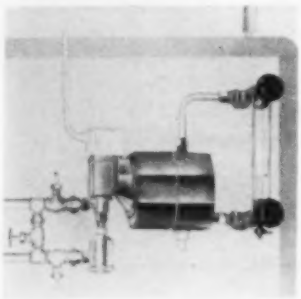
Removes Condensate From Air Conditioning Equipment



No. 4042*—The model No. 2 condensate disposal unit, developed by Eastern Industries, Inc., 296 Elm St., New Haven 6, Conn., is said to be especially suitable for removing small quantities of condensate from air conditioning equipment.

Fully automatic and of rustproof construction, it is equipped with a bronze, centrifugal sump type pump, a 1½ gal brass receiver, a float operated switch, a check valve on the outlet side of the pump, and a 1/40 hp, single phase, 115 volt motor. The pump is said to deliver 4½ gpm at 0 psi and to have a shutoff pressure of 12½ psi.

Nonferrous Construction Used in Boiler Water Level Controls



No. 4043—A complete new line of "Water-Boy" boiler water feeders and low water cutoffs is being offered by Maid-O'-Mist, Inc., 3217 N. Pulaski Rd., Chicago 41. Designated as the 500 series, these controls are of brass and copper construction and a new type switch, used as a circuit breaker in the cutoff, is said to have high electrical capacity without pitting or sticking.

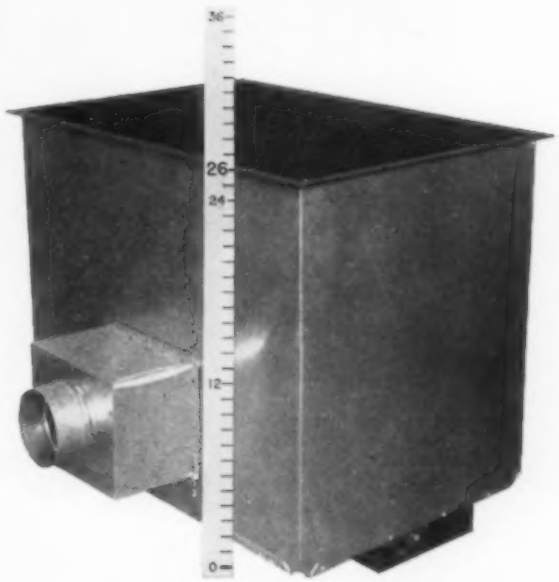
All units are provided with a built-in type blowoff valve, strainer, and fittings designed for rapid hook-up. They are said to be compact, streamlined, and light in weight, the combination feeder and cutoff weighing less than 6 lb.

Ventilating Fan Fits Into Upper Panel of Standard Window

No. 4044—A portable, direct drive window fan for ventilating smaller areas is offered by Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington 11, N. J. The type WPJ fan is recommended for use in offices, apartments, and hotel, hospital, and conference rooms.

The unit is designed to fit into the upper panel of a standard window permitting the raising and lowering of the upper sash at will. It is adjustable from 25 to 36 in. and is furnished with pull-chain switch and plug-in extension cord. The 12 in. fan is said to deliver 1000 cfm and is driven by a 1/25 hp motor.

JOHN ZINK "SHORTY" FLOOR FURNACE



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Aldrich Oil Burners, with Aldrich-built transformers and motors and complete automatic controls, come in 3 models, 5 firing ranges, ¾ GPH to 19 GPH. Exclusive design and construction features make them ideal for conversion, replacement, or original equipment. Write for literature! Get the EXTRA ADVANTAGES only Aldrich offers!

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You'll find that your sales pick up immediately when you put the same effort into selling Aldrich that you put into another line . . . for Aldrich has a wider variety of sizes, EXTRA competitive advantages.

With Aldrich you offer a heating and/or hot water supply unit that meets the exact needs of each prospect.

A big sales clincher for boiler-burner prospects are the interchangeable, identically rated oil and gas burners. Other features include exceptional compactness, improved design for more economical operation with either gas or oil, and such practical advantages as larger access plates for easier servicing.

Aldrich Oil Burner Advantages include interchangeable draft-tube assemblies giving one burner three firing ranges — you can serve a maximum number of prospects with minimum stock. Construction and performance features of the Aldrich let you meet and beat any competition.

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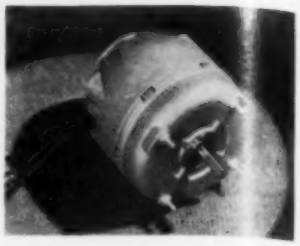
Designs Unit Bearing, Shaded Pole Motor for Portable Equipment



No. 4045—A new line of unit bearing, shaded pole, fractional horsepower motors has been designed for use on portable equipment by General Electric Co., Fractional Horsepower Motor Divisions, Schenectady 5, N. Y.

Designated as type KSP71, the motors are available in 1/40 hp, 60/50 cycle, totally enclosed; 1/25 hp, 60 cycle, totally enclosed; and 1/15 hp, 60 cycle, open. All ratings are available for 115 or 230 volts and for clockwise or counter clockwise rotation.

Recommended for use with fans, blowers, and small pumps, units have a die cast aluminum frame and are available in a variety of mountings.

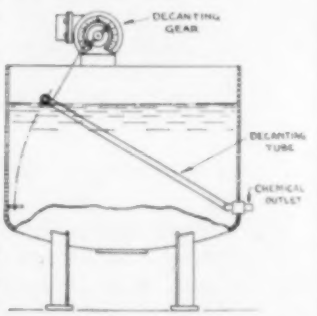
New Body Design Permits Smaller Valve Installations

No. 4046—A new design for cast steel valves has been developed by Edward Valves, Inc., East Chicago, Ind., which is said to make possible the installation of a size smaller valve in pipe lines.

Stop and nonreturn valves in either the globe or angle design use the new body for all sizes 6 in. and above in 900, 1500, and 2500 lb classes. They are available with pressure seal or bolted bonnet and with flanged or welding ends.

Pressure loss in the new body design, says the firm, is decreased by streamlined internal contours which eliminate wear producing turbulence, by reduction of weight in all floating parts, and by equalization of pressures in all internal areas of the valve.

Decanting Gear Used with Precipitating Type Water Softeners



No. 4047 — Worthington Pump and Machinery Corp., Harrison, N. J., is offering a decanting gear for use with water softeners of the precipitating type. It automatically lowers the swing pipe decanting tube in the chemical agitating tank to feed chemical to the softener in proportion to the raw water flow. Its operation is paced by the raw water meter.

The dial indicates the amount of chemical liquid in the tank and connections are provided for the attachment of an electric low level alarm. The decanting tube is positioned by a flexible cable attached to the shaped and grooved drum. Rotation of the drum pays off cable and lowers the decanting tube.

The contour of the drum is designed to compensate for the inaccuracy which would otherwise be introduced by the radial path described by the receiving end of the tube during its downward travel. When desirable to recharge the chemical tank, the decanting tube is raised to its starting position by cranking.

The drum is driven through oil immersed gears by a 1/40 hp synchronous motor inclosed within the housing.

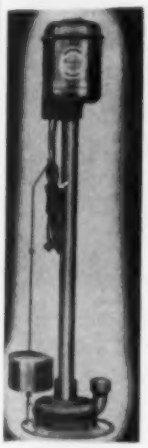
Taper Bushing Used in Rigid Coupling

No. 4048—A new rigid coupling for connecting the ends of two shafts has been announced by Dodge Mfg. Corp., Mishawaka, Ind.

This new application of the "Taper-Lock" bushing, first introduced for v belt sheaves and later in a flexible coupling, takes the place of the firm's flange couplings in sizes up to and including 2-15/16 in. and is furnished also in sizes up to and including 5 in. It also replaces the ribbed and compression couplings formerly furnished.

The new unit is designed to permit easy coupling or disengagement of shafts, and the equivalent of a shrunk-on fit is said to be obtained by tightening two set screws. It has a male and female joint and is machined all over.

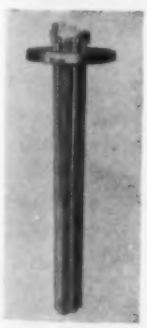
Sump Pump Designed for Wide Range of Uses



No. 4049—A new sump pump, available from Skidmore Corp., St. Joseph, Mich., has been designed for a wide range of uses and unusual working conditions. With a maximum water removal capacity of 3000 gph, it is recommended for drainage of boiler rooms, elevator pits, and similar commercial and industrial applications.

It is of bronze construction with a copper float and stainless steel shaft. The motor is said to be fully sealed and impregnated for moisture resistance. The screen is 12 times the suction area and the bronze pump housing has a vertical discharge outlet. Motor size is ¼ hp.

Offers Electric Immersion Heaters for High Temperature, Pressure Use

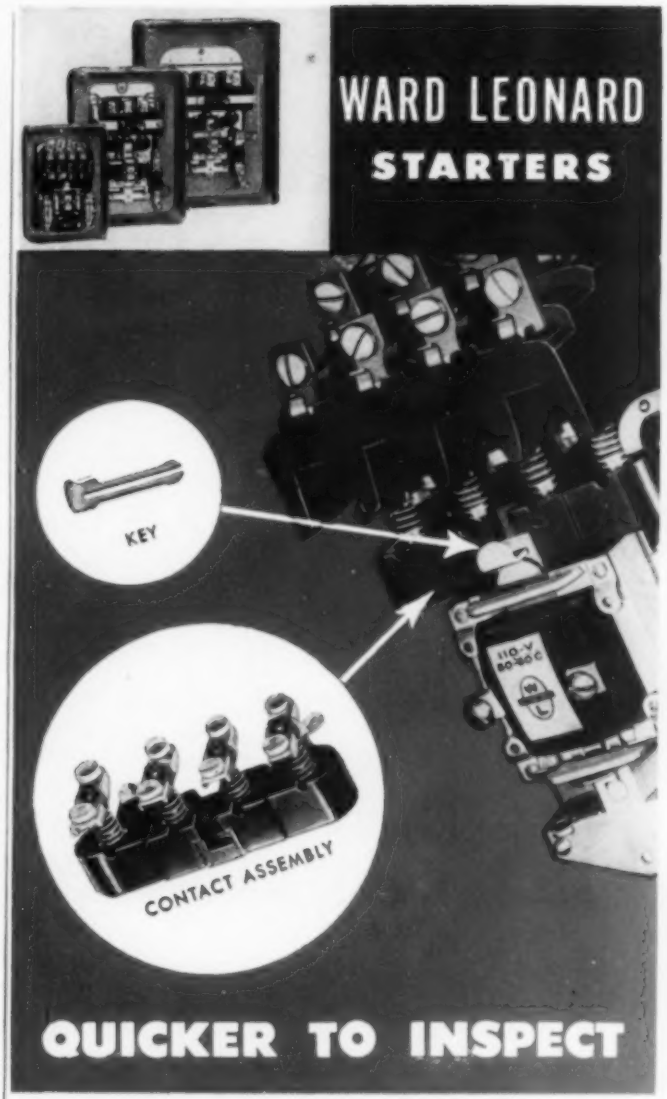


No. 4050—A new line of "Chromalox" multiple element, electric immersion heaters for high pressure high temperature applications is offered by Edwin L. Wiegand Co., 7610 Thomas Blvd., Pittsburgh.

Capacities of the heaters, designed type TMO, vary from 1 to 100 kw, depending upon the job for which they are needed, and are obtained by arranging groups of tubular elements in heavy mounting flanges.

The hairpin shaped elements, of triangular cross-section, are welded into forged steel flanges and are arranged so as to permit the liquid to circulate freely. Units are available in steel, stainless steel, or inconel sheaths.

According to the company, units are ideal for preheating air and other gases and for superheating steam.



because contactor parts are ACCESSIBLE

Removing a single key permits the entire moving contact assembly to be withdrawn for inspection of all main silver contacts, both moving and stationary.

And it's easier to replace main stationary contacts, too, due to the use of individual spring retaining clips.

Write for Bulletin 4110. It fully describes Ward Leonard's new Size 1, 2 and 3 across-the-line, non-reversing AC magnetic starters. Ward Leonard Electric Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

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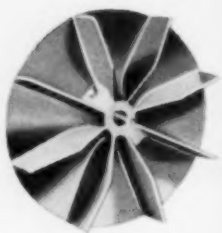

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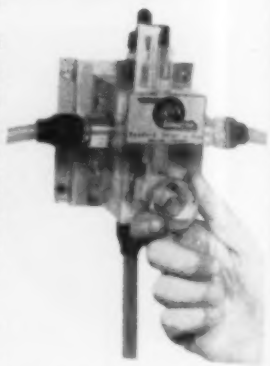


No. 4051** — The "Sureclor" automatic "hypo-feeder" has been developed by Paddock Engineering Co., 3727 Atwell St., Dallas, Tex., and is said to be an inexpensive device for feeding chlorine into cooling water in order to prevent the accumulation of algae and slime in cooling towers, condensers, and valves.

Designed for use on any pressure water system, it operates on a vacuum principle with no moving parts other than check valves. It is constructed of clear plastic, said to be impervious to the reaction of chlorine and is equipped with a built-in testing unit for visual control of the chlorine content of water. It may also be used with other water soluble chemicals.

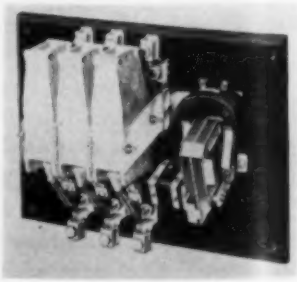
Introduces Packaged Burner for Gas Fired Boilers

No. 4052—Complete automatic burner assemblies for gas fired boilers from 10 to 180 hp have been introduced by Bryant Industrial Div., Affiliated Gas Equipment, Inc., 1020 London Rd., Cleveland 10.

Only gas piping and electric wiring are needed to complete the installation of the new series BB boiler burners which are shipped as complete packages. Principal element of the unit is the "Pow-R-Sembly," including constant pressure blower, single or double burner nozzles each with compact proportional mixer, zero regulator, motorized air valve, electric ignition pilot, and manual reset safety gas valve. Steam pressure controls, or remote thermostatic control, or both are furnished.

The burners operate automatically over three steps of heat output. For light loads, the pilot operates, while the main burner automatically takes over at "low fire" or "full fire" as required. Valves furnished are sized for manufactured and mixed gas, or for natural and LP gas. Square flange connections are used throughout to make possible a flexible arrangement of elements to suit installation space available.

Recommends Magnetic Contactors for Motor, Heater, and Lamp Control Use



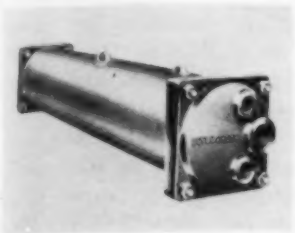
No. 4053—Ward Leonard Electric Co., Mount Vernon, N. Y., is offering Bulletin 4454 size 4 and size 5 a-c magnetic contactors for motor, heater, and lamp control purposes.

Some of the standard features incorporated on these 150 and 300 amp con-

tactors are said to include movable and stationary contacts on both sizes which are identical and interchangeable, removable cold molded arc shields for all main poles, an entirely new magnetic circuit permitting positive operation over a wide range even under fluctuating line voltages, and accessible solderless clamp type connectors for line and load terminals.

Size 4 contactors are available with a maximum of five main poles and size 5 units with two or three poles only. Both sizes can be supplied with open type construction or with NEMA Type I enclosures. Coils are obtainable for operation on 110, 208-220, 440, and 550 volts and on frequencies of 25, 50, or 60 cycles.

Refrigeration Condenser Has High Heat Transfer, Pump Down Capacity



No. 4054—Doyle & Roth Mfg. Co. Hawkins St. and C.R.R. of N. J., Newark 5, N. J., is offering a new line of "Junior Freon" condensers for air conditioning and refrigeration applications. These units are designed for ranges between 1½ and 25 tons, and are available from stock.

Features of construction are said to include tubes which are rolled into reamed and serrated holes and are cleanable and may be easily removed and replaced, high heat transfer, pump down capacity for refrigerant storage eliminating the need for a receiver, and a design affording water economy consistent with efficient operation.

Equipment Shorts

Jenkins Bros., New York City, has obtained a long term lease for the entire 30th floor in the tower of the 36-story, fully air conditioned New York office building under construction at 100 Park Ave. The new structure, which is the first skyscraper to be erected in the Grand Central area since the early 1930's and one of the largest rental office building projects in the country, is scheduled for completion next February. The company has occupied its present quarters at 80 White St. for more than 30 years.

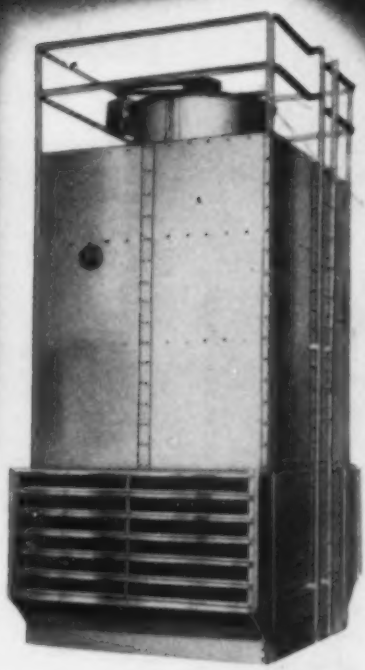
New orders recently booked by **York Corp.,** York, Pa., include one for the General Accounting Office of the U. S. Government. This covers the installation of four turbo systems with an air conditioning capacity of 4200 tons. The Chilean Nitrate Sales Co., of New York, has ordered more than 600 tons of physical weight of equipment having a refrigeration capacity of 680 tons. When installed in Chile, the equipment will be used for the preservation of food and the production of nitrate crystals for the fertilizing and chemical industries.

Reynolds Metals Co., Louisville, Ky., has purchased a government owned aluminum extrusion plant at Grand Rapids, Mich. Built during the war at a cost of over $6 million, it is designed for the production of rod, bar, shapes, and tubing and has a rated annual capacity of 10,800,000 pounds of aluminum. Its wartime operator was Extruded Metals, Inc. In 1946 Reynolds signed a 5-year lease to operate the plant, but in 1947 it was closed because of a gas shortage. Operations are being resumed

NEW MARLEY *Verflow**

An "*Extra Quality*" Tower

. . . At No Extra Cost



The New Marley VERFLOW sets a new standard in air conditioning and refrigeration Cooling Towers.

Check these "extra quality" features formerly found only on heavy duty, industrial cooling towers that are now available on all Marley wood or steel VERFLOWS at no extra cost to you . . .

√ Lifetime nail-less filling. √ Filling that can be removed and reinstalled in a matter of minutes. √ Totally enclosed motors. √ Enclosed bearing housings with grease packed bearing. √ Marley air-foil section cast aluminum alloy fans. √ Special corrosion-resistant paint on metal towers. √ Heavy double-sheathed wood casing on wood towers. √ Patented, close-centered Marley jet action spray nozzles in balanced distribution system. √ Hinged louver frames and removable louvers. √ Quickly erected, easily operated with little maintenance time.

These and other "extra quality" features make Marley VERFLOW the best buy on the market. Many special accessories such as Geareducer drive, handrail and ladder are also available at a small added cost.

Ask your nearest Marley representative to tell you more about the VERFLOW or write for Bulletin V-49.

MARLEY COOLING TOWERS

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A Complete Unit for a Complete job

You're always *sure* you're getting the very best in efficient, economical packaged air conditioning when you specify Governair—the original patented design!

This complete unit is easy to install—requires only simple electrical, water and duct connections. Built-in Evaporative Condenser keeps water usage down to a minimum. Governair engineering assures correct coordination and balance of all functions. Generously proportioned heat transfer surfaces provide maximum performance and economy.

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Would you like to know how Air Conditioning jobs can be installed for from $100.00 to $400.00 per ton less?

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and peak production is expected to be reached in a few months.

C. A. Dunham Co., Chicago, has completed a one-story addition to its Michigan City, Ind., factory. According to H. S. Marshall, president, the need for expanded facilities has been occasioned by growing sales. Part of the new building is being used for the storage of finished products just prior to shipment and the balance houses the order and billing departments. . . . **Cochrane Corp.,** Philadelphia, has purchased substantially all of the capital stock of **Liquid Conditioning Corp.,** Linden, N. J. The new acquisition is operating as a wholly owned subsidiary and its products are continuing to be marketed under the trade name "Liquon". District sales offices are now combined with Cochrane sales offices.

A plant consisting of industrial buildings containing 90,000 sq ft and located on an eight acre tract at Mt. Vernon, Ill., has been purchased by **Wagner Electric Corp.,** St. Louis. The company is concentrating its facilities for building transformer tanks at the new plant which, with other purchases and additions, represents an increase in manufacturing capacity of approximately 50 percent since the end of the war. . . . **Airkem, Inc.,** New York City, recently moved into its new quarters at 241 E. 44th St., where many of the firm's activities are now concentrated. This move is the third time the company has expanded to larger quarters since its inception in 1941.

A price reduction of 7 to 19 percent on its multiple v belt drives has been made by **Allis-Chalmers Mfg. Co.,** Milwaukee. Reductions apply to all types of belts, sheaves, and accessories sold under the trade name "Texrope". The company has also discontinued its adjustable threaded plate sheaves in the larger sizes and recommends that "Vari-Pitch" sheaves be substituted. The reason given for this change is that users have tended to overload the larger size adjustable sheaves without properly anchoring the adjusting plates . . . The first meeting of the national distributor sales advisory committee of **York Corp.,** York, Pa., was held recently. Key distributors and management personnel discussed virtually all phases of relations between customers, distributors, and the company.

Technical and commercial aspects of "Ni-Resist," a cast nickel alloy, are being discussed at a series of meetings sponsored by **International Nickel Co.,** New York. In cities throughout the country and in Montreal, the meetings are bringing together representatives of the licensed producers of the alloy and technical and commercial personnel of the company. . . . During the recent annual sales conference of **National Radiator Co.,** Johnstown, Pa., 16 new products were unveiled to sales representatives. Special emphasis was devoted to new merchandising plans and selling aids.

Under the terms of a license agreement recently signed, **York Corp.,** York, Pa., will manufacture certain refrigeration coils using the tap water defrost method patented by **Refrigeration Engineering, Inc.,** Los Angeles. This brings the number of manufacturers operating under this agreement to a total of 11. . . . An exhibit featuring the oil heating equipment manufactured by **Petroleum Heat and Power Co.,** Stamford, Conn., was held on the banking floor

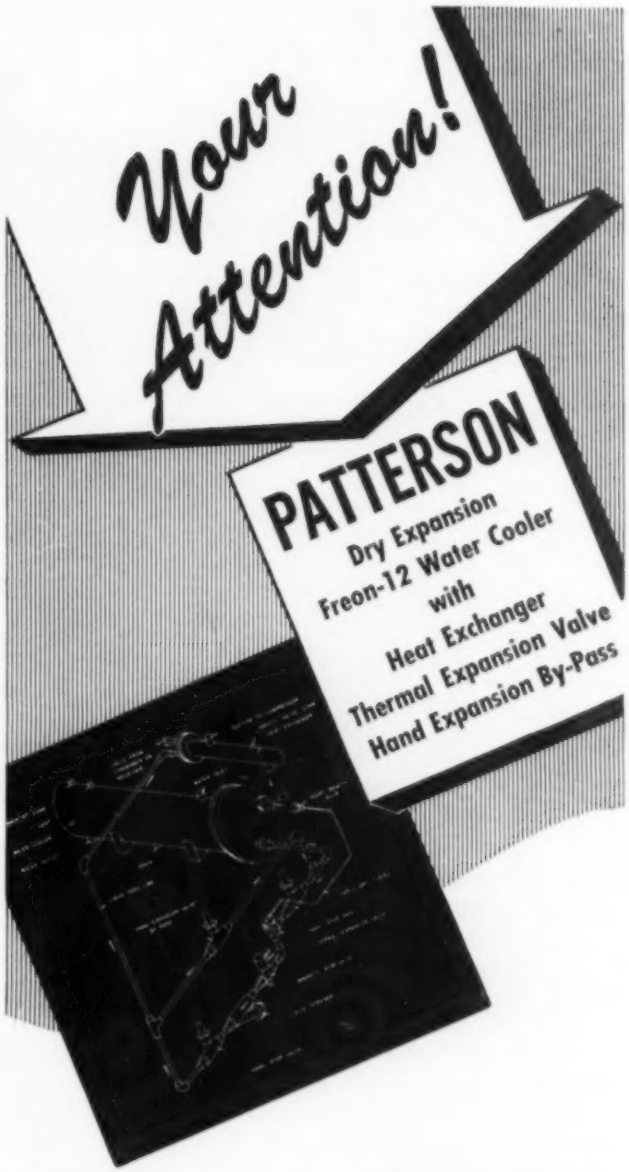
of the Stamford Trust Co. The one month showing was the second in a continuing series of demonstrations planned by the bank to dramatize the importance of local industrial production.

A method of keeping principal customers advised of stock availability of products in which they are interested has been introduced by **SKF Industries, Inc.**, Philadelphia. The monthly inventory-availability service calls to the attention of leading customers in each of the firm's sales territories the items they use that are in stock or are expected to be in stock within a 30 to 90 day period. . . . The second in a series of service schools on flowmeters was held at the home office of **Hays Corp.**, Michigan City, Ind. About 50 service engineers from the midwest group of company representatives, including those at the parent plant, attended. Similar schools will be held in various sections of the country.

Super Radiator Corp. celebrated its 20th anniversary with the opening of a new office and factory building in St. Louis Park, Minneapolis, and announced an expanded sales program to distribute products nationally through factory representatives located in principal cities. . . . The name of **Independent Oil Burner Corp.** has been changed to **Sun-Ray Burner Mfg. Corp.**, with offices and factory located at Jamaica, N. Y. . . . The tube expander business of **Richard Dudgeon, Inc.**, New York City (including inventory, engineering data, and sole manufacturing rights), has been purchased by **Thomas C. Wilson, Inc.**, Long Island City, N. Y. The Wilson firm is combining the manufacture of its tube cleaners with the newly acquired expanders and the Dudgeon company is now concentrating on the production of hydraulic machinery.

Sales of cathodic protection products for retarding electrolytic corrosion of pipelines and industrial equipment have been transferred from the magnesium sales division of **Dow Chemical Co.** to **Dowell, Inc.**, a wholly owned Dow subsidiary. The Dowell organization has headquarters in Tulsa and maintains some 45 offices and field stations throughout most of the oil producing and industrial areas of the country. . . . **Schaible Co.**, Cincinnati, has completed a new warehouse adjoining the parent plant. According to the firm, straight line production techniques will be expedited by the new facilities. . . . **Wilson Engineering Corp.**, Chicago, has purchased the manufacturing and assembly plant facilities of **J. T. McGrath & Sons**, Bloomington, Ill.

Developed in the research laboratories of **International Nickel Co., Inc.**, 67 Wall St., New York 5, a new material described as ductile cast iron is said to combine the process advantages of grey cast iron and the product advantages of cast steel. It is characterized by a graphite structure in the form of spheroids, free from graphite in the flake form. Production of the iron can be applied to common cast iron compositions melted in the cupola or in other kinds of furnaces and is based on the introduction of a small amount of magnesium or a magnesium-containing addition agent such as nickel-magnesium alloy. Potential applications, says the company, are many and include machinery in general, engine and furnace parts used at high temperature, pipe, and marine equipment.



It's a compact, efficient, and effectively controlled water cooling system with a wide range of capacities. It's a carefully engineered system with each size conservatively rated. Perhaps it is just what you need for your cooling requirements. If not, we have other combinations.

Our new Freon Cooler Catalog gives details of over 100 different sizes ranging from 18.4 to 1421 square feet of cooling surface. If our standard units will not provide the unit needed, we are in position to design special coolers, special both as to type and to size. In sending for this catalog, outline your cooler requirements; keeping in mind that the design and manufacture of coolers and other "heat transfer" equipment has been our specialized business for many, many years.

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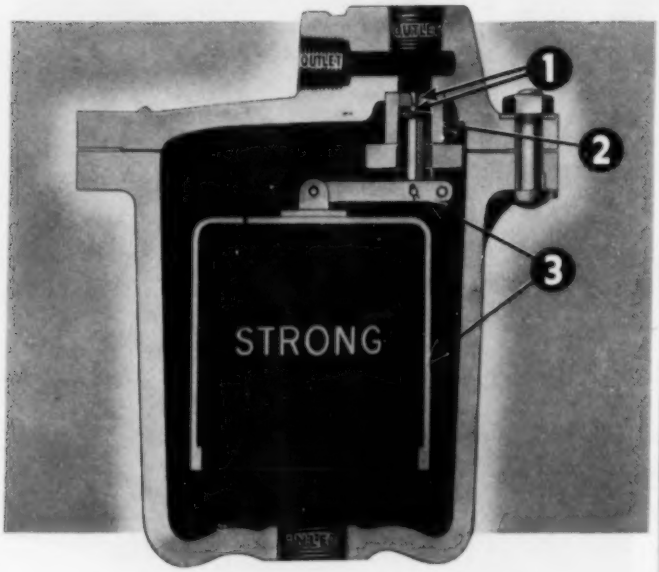
3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68 describes inverted, open bucket and other types of STRONG traps. Write today.

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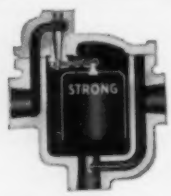
OTHER STRONG STEAM SPECIALTIES

Reducing Valve



70 Series Trap

Strainer

STRONG

WHO'S WHAT

At a special meeting of the board of directors **T. S. Pendergast** was elected a director and president of **Baker Refrigeration Corp.**, South Windham, Me. He has been general manager for the past six months and will continue in charge of manufacturing and sales. **C. M. Hatcher** is now advertising and sales promotional manager. . . . **John J. Hall**, formerly vice president and general manager of sales, has been elected president of **Richmond Radiator Co.**, New York City, an affiliate of Reynolds Metals Co. Prior to joining the company in 1944 he was vice president, general sales, of American Radiator and Standard Sanitary Corp. The new executive vice president and the new vice president and treasurer of Richmond are **P. E. Winnia** and **M. H. Temple**, respectively. **Cecil W. Farrar** is now general manager of sales.

Three new directors and two new vice presidents have been named by **Dravo Corp.**, Pittsburgh. The new directors are two company men; **Louis A. Mertz**, vice president and treasurer, and **Howard H. Sturdy**, general manager of the contracting division; together with **Gordon W. Cameron**, treasurer, Aluminum Co. of America. The new vice presidents are Mr. Sturdy and **Byron R. Rhoads**, chief engineer of the contracting division. Recent changes in the company's advertising department include the appointments of **Thomas M. Fallon** as manager of advertising for the machinery division, **George J. Newhams** as advertising manager for the engineering works division, and **Edward P. Pearsall**, manager of corporation publications.

Dr. Harry K. Ihrig, vice president and director of laboratories, **Globe Steel Tubes Co.**, Milwaukee, recently received a citation for distinguished service in engineering from the University of Wisconsin. . . . **Walter V. Davidson, Jr.**, is now assistant to the president of **W. B. Connor Engineering Corp.**, New York. He was formerly associated with a management engineering firm. . . . **Avery Products Co.**, Cleveland, has recently been formed and has taken over the sale of packaged air conditioning units and other special items formerly sold by the merchandise department of **Avery Engineering Co.** Officers of the new firm are: **Lester T. Avery**, president; **Dwight E. McLean**, vice president; **Joseph E. Wilhelm**, treasurer; and **Ethel Barnes**, secretary. The older organization is concentrating on commercial and industrial work in air conditioning and refrigeration and will install and service equipment sold by the new company.

Fisher Governor Co., Marshalltown, Iowa, has appointed **George R. Friederich & Co.** as its district sales representative in the San Francisco area. According to the company, Mr. Friederich has been associated with Fisher since 1930, and since 1934, has been Pacific coast sales manager. His headquarters office is at 725 Tehama St., San Francisco 3. . . . A number of changes in branch managerships of **National Radiator Co.**, Johnstown, Pa., include the appointment of **Alex K. Tinker** as manager of the New York sales office. **Fred S. Hudson**, formerly of the Washington branch, has succeeded him as Pittsburgh manager. **Robert E. Daly** has been named north-

western district sales representative and has established offices at 3355 E. 182 St., Seattle 55. He has had more than 30 years of experience in the heating field, was a member of the I-B-R technical committee which developed the rating and testing code, has served as a member of the Department of Commerce committee on simplified practice recommendations for radiators, and was formerly associated with American Radiator and Standard Sanitary Corp.

A. N. Martin, vice president of **Pyle-National Co.,** Chicago, has retired after 31 years of service. He joined the company in 1918 as a purchasing agent and in 1927 was elected a vice president and was placed in charge of the New York office where he remained in that capacity ever since. **T. W. Milligan** is the new manager of the central sales division, with headquarters in Chicago, and **James V. Baker** is assistant manager of the division with headquarters in Cleveland. . . . Presentations of the 1949 Willis Rodney Whitney Award to **R. B. Mears,** manager of the research laboratory at Carnegie-Illinois Steel Corp. and the 1949 Frank Newman Speller Award to **F. L. LaQue,** in charge of the corrosion engineering section, International Nickel Co., Inc., were made at the recent annual banquet of the **National Association of Corrosion Engineers.** Mr. Mears is the incoming president and Mr. LaQue is past president of the association. Determination of those to receive these awards is made by ballot among association members.

Byron E. James has assumed the post of chief engineer of **McQuay, Inc.,** Minneapolis. He was formerly chief engineer and general manager of Liquid Carbonic Corp. and before that was manager of equipment development for York Corp. . . . **T. H. Banfield,** president of **Iron Fireman Mfg. Co.,** has been elected a member of the board of directors of **Stanford Research Institute,** according to an announcement by Clarence H. Faust, acting president of Stanford University, Palo Alto, Calif. . . . **C. R. Freberg,** formerly head of the engineering division, Southern Research Institute, is now director, equipment research division, of the newly established **U. S. Naval Civil Engineering Laboratory,** Solomons, Md. This unit works with the Bureau of Yards and Docks on equipment, structures, and materials used by the Navy department on shore. It will also carry out a program of basic and applied research. Mr. Freberg is co-author of an article on special fills for heat pump ground coils, published in last month's HPAC.

J. B. Kingsley, who has been with **International Boiler Works Co.,** East Stroudsburg, Pa., for over 20 years, is now president and general manager. He had been general manager and vice president . . . The new Denver representative for **Illinois Engineering Co.,** Chicago, is **Kent Engineering Co.,** 522 Chamber of Commerce Bldg. . . . **Harry Himelblau** has formed the firm of **Himelblau Associates,** 122 W. Kinzie St., Chicago 10, to represent heating, ventilating, and air conditioning manufacturers in the Chicago area, and accounts are being established. Formation of the firm follows his retirement from **Himelblau, Byfield & Co.,** Chicago, and the sale of his interest therein to **A. L. Byfield** and **George V. Zintel,** now secretary of the organization which continues under the same name.

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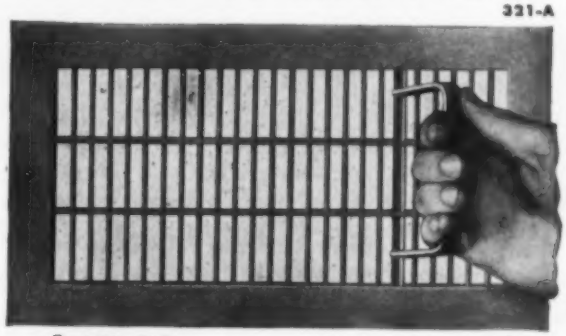
"Fabrikated" WALL GRILLES for Commercial Installations

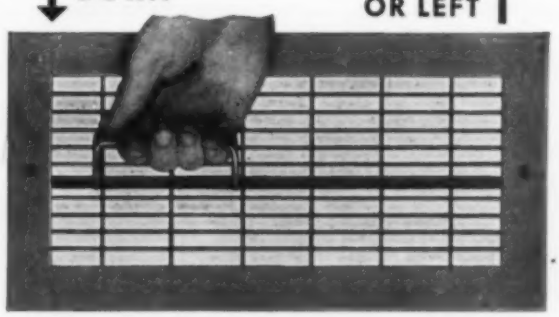
PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT



311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 48—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

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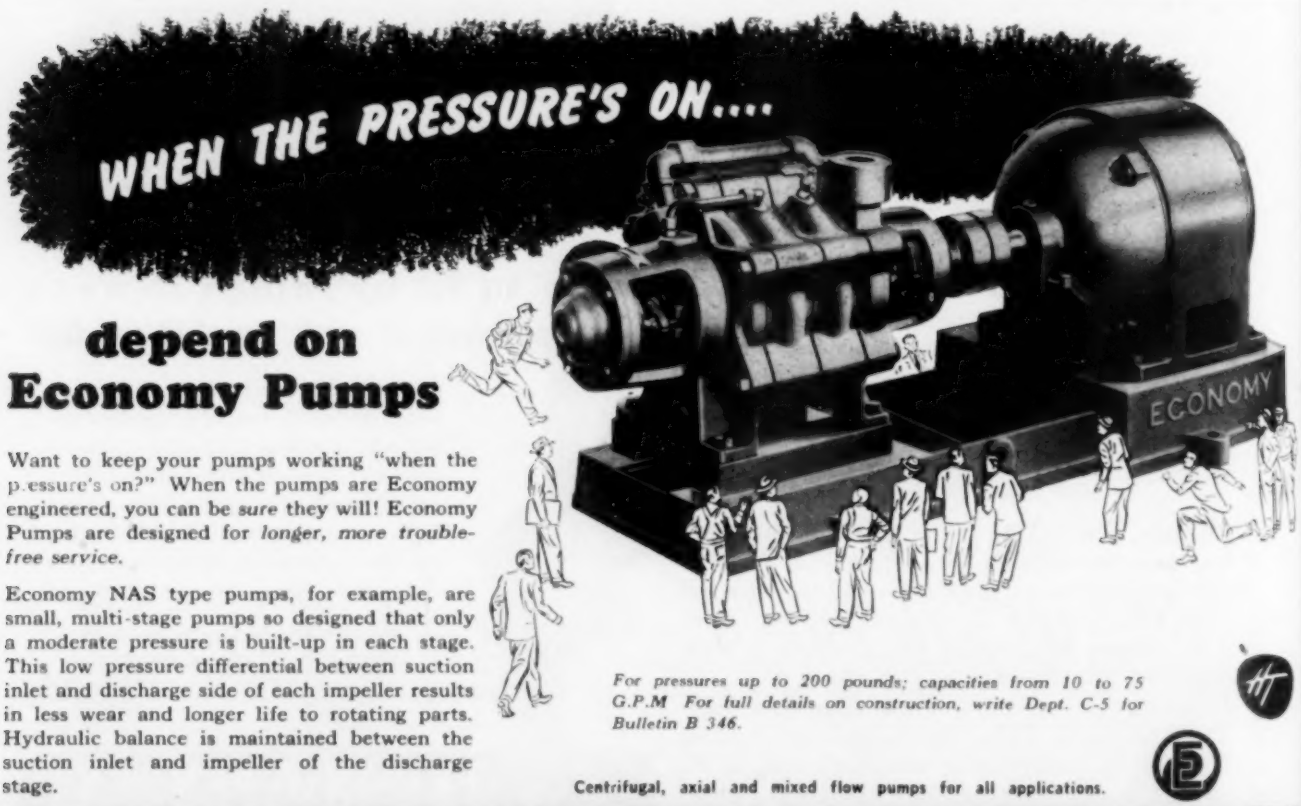
A standards committee of the **American Society of Refrigerating Engineers** has been established to set up rating and testing standards for desiccants. Chairman of the group is **W. O. Walker,** Ansul Chemical Co., and other members include: **L. H. Bartlett,** Louisiana State University; **R. E. Cherne,** consulting engineer, Rochester, N. Y.; **W. A. Pennington,** Carrier Corp.; **W. F. Wischmeyer,** Sporlan Valve Co.; **R. L. Williams,** Kinetic Chemicals, Inc.; and **P. L. Veltman,** Davison Chemical Co. . . . **Harold F. Stamps** has announced his resignation as field engineer for Henry Valve Co., Chicago.

Lockwood Greene Engineers, Inc., architects and engineers with offices in Boston, New York, Spartanburg, S. C., and Montreal, has elected **Samuel B. Lincoln** president to succeed Chester S. Allen who is now chairman of the board. . . . **L. J. Krause Co.,** 200 Lumber Exchange, Minneapolis 1, manufacturers' representative, has recently been formed and is soliciting exclusive agency representation for heating, air conditioning, and refrigeration equipment. The territory to be covered includes Minnesota, North and South Dakota, Iowa, and western Wisconsin. . . . With headquarters in Dallas, **K. G. Schick** is the new sales representative for **National Radiator Co.,** Johnstown, Pa., covering the eastern portion of Texas.

K. B. Thorndike, vice president, Detroit Lubricator Co., Chicago, is the newly elected president of the **Refrigeration Equipment Manufacturers Association.** He succeeds H. F. Hildreth, manager, refrigeration specialties dept., Westinghouse Electric Corp. Other new officers are: Vice President—**R. H. Israel,** sales manager, refrigeration dept., Virginia Smelting Co.; Treasurer—**W. A. Siegfried,** president, Superior Valve & Fittings Co.; Secretary—**W. J. Stelpflug,** vice president, Hussmann Refrigeration, Inc. These officers, with Mr. Hildreth, are the executive committee of REMA for the current fiscal year. . . . **Tinnerman Products, Inc.,** Cleveland, has established a new division for handling its nut retainer and has appointed **Charles E. Pearson** coordinator of sales, production, and engineering of the new product.

Stanley S. Willis, who has been with **Kerotest** Mfg. Co., Pittsburgh, since 1931 and who has been production planning manager over all operations for the past 11 years, is now district manager of the firm's brass division. His territory includes Indiana, Illinois, Wisconsin, Minnesota, North and South Dakota, and Montana. His headquarters are at 568 W. Randolph St., Chicago. **Kenneth F. Vilsack** was recently named steel valve representative for the same territory. . . . **American Structural Products Co.,** a subsidiary of Owens-Illinois Glass Co., has assigned insulation sales engineers **William A. Lloyd** to Washington, D. C. and **Isaac Keith** to St. Louis. With headquarters at 1627 K St., N.W., Mr. Lloyd will cover Maryland, Virginia, and part of North Carolina. Mr. Keith, located at 601 Continental Bldg., will operate in Kansas, Missouri, Arkansas, southern Illinois, western Kentucky, western Tennessee, and northern Mississippi.

John B. Hewett, who for 10 years was sales manager of Anemostat Corp. of America, has acquired the **William W. Short Co., Inc.,** New York. Organized and operated by the late Mr. Short, the company will continue to repre-



depend on Economy Pumps

Want to keep your pumps working "when the pressure's on?" When the pumps are Economy engineered, you can be *sure* they will! Economy Pumps are designed for *longer, more trouble-free service.*

Economy NAS type pumps, for example, are small, multi-stage pumps so designed that only a moderate pressure is built-up in each stage. This low pressure differential between suction inlet and discharge side of each impeller results in less wear and longer life to rotating parts. Hydraulic balance is maintained between the suction inlet and impeller of the discharge stage.

For pressures up to 200 pounds; capacities from 10 to 75 G.P.M For full details on construction, write Dept. C-5 for Bulletin B 346.

Centrifugal, axial and mixed flow pumps for all applications.

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197 Pages — 8½" x 11" — $1.50

This practical book is made up of outstanding papers and data on industrial piping selected from past issues of "Heating, Piping & Air Conditioning." It is a most comprehensive collection of case studies, showing how various difficult piping problems encountered in different industrial plants were successfully worked out by piping experts.

Design, installation, operation, and maintenance . . . steam, air, gas, oil, process, water and refrigeration piping . . . piping in pulp and paper and steel mills, in automobile plants and breweries, in the food and chemical and textile industries, and in many other types of manufacturing plants are dealt with from many different angles.

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You can frequently trace accidents, work spoilage and low production to insufficient ventilation. A large proportion of these problems in industrial buildings can be solved with gravity-type roof ventilators.

Swartwout-Dexter Heat Valve (above) and AIRMOVER (top right) are two of the most successful systems of this type. Scientifically designed to permit upward movement of hot air, smoke and fumes with least resistance, their construction also takes advantage of outside air movement and wind suction effect.

Weatherproof at all times . . . they can be closed when desired. Swartwout Ventilators are used on thousands of factories, foundries, warehouses, etc.

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Controlled **Air Circulation**
EQUIPMENT FOR EFFECTIVE ECONOMICAL VENTILATION OF INDUSTRIAL BUILDINGS

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Make a cool profit

THIS SUMMER

with FAN-PAC

PACKAGED VENTILATION

Ideal for

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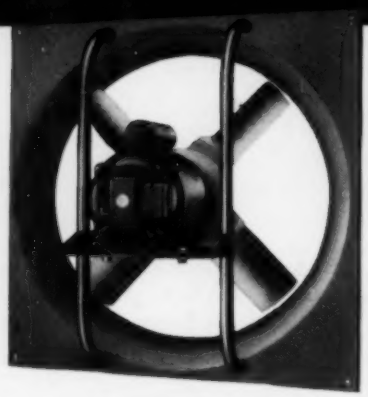

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Available in 16", 18", 20", 24" sizes.

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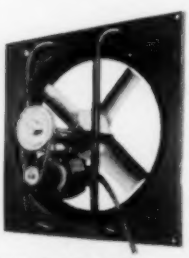
Here's a valuable inside tip for cool summer profits! Business establishments everywhere seek ways and means of creating increased employee efficiency during hot, sultry weather. FAN-PAC is the answer, circulating cool, fresh air for more healthful, comfortable working conditions. Increased customer traffic and new patronage is also the result of FAN-PAC easy-to-install Packaged Ventilation. Cash in on this huge market! Build a bigger summer business for yourself by investigating FAN-PAC *TODAY!*



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3. Square Panel Mounted for Easy Installation
4. Scientifically Correct Air Inlet
5. Cushioned Motor Mountings for QUIET Operation
6. Motors of Nationally Recognized Make

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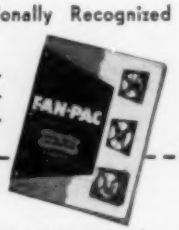

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sent a number of manufacturers of diffusers, registers and grilles, coils and condensers, fans and blowers, electrostatic precipitators, and regulator controls. Sales activities will cover the greater metropolitan district of New York, Westchester County, Long Island, and northern New Jersey. . . . The new Denver representative of **Allen-Bradley Co.**, Milwaukee, is **Young Electric Mfg. and Supply Co.**, 2134 Curtis St. **W. E. Young** is the owner and manager. **Bowditch and Co.**, another factory representative, has expanded its Knoxville, Tenn., operations by opening a new office in Memphis at 1350 Monroe Ave. **Francis Bowditch** is in charge.

Six employees of **The Detroit Edison Co.** have been named winners of the 1948 Alex Dow Award for outstanding service to the company. Among the technical men named, **I. Arthur Rohrig**, metallurgist in the research dept., won an award for his work on graphitization of carbon and carbon-molybdenum steels in high temperature service. **Robert Rutherford**, instrument repairman, was honored for his improvements to power plant apparatus. Some of his contributions include a vacuum clean-out device used when stoker ram boxes become plugged, built-in illumination for the operating barometer, a system of tubes directing compressed air across the inner glass face of air flow, steam flow meters to keep them clear of condensed oil vapor, and special protective bushings and shields for precision thermometers.

American Hydrovac, Inc., Brooklyn (formerly Ames Hydrovac, Inc.), has named **Paul P. Emery** sales manager. He has had many years of sales supervision experience in the vacuum and condensate pump field. . . . The packaged air conditioning sales division of **United States Air Conditioning Corp.**, Minneapolis, has announced a number of new distributors. **Fidelco, Inc.**, 207 E. 37th St., New York, entering its 10th year covers the city and Long Island. Also celebrating its 10th anniversary, **Refrigeration Equipment Co.**, Kansas City, Mo., is under the direction of **E. L. Tramposh** and has branch offices in Wichita, Topeka, and St. Joseph, Mo. **J. M. Oberc, Inc.**, Detroit, is the new exclusive distributor in southeastern Michigan.

Representation of **Baltimore Aircoil Co., Inc.**, Baltimore, is being handled in the state of Georgia and the northern part of Florida by **J. Harvey Seat & Associates**, 157 Simpson St., N.W., Atlanta. **Hoffman & Hoffman Co.**, Box 2211, Greensboro, N. C., is covering both North and South Carolina. . . . The Richmond, Va., sales branch of **National Radiator Co.**, Johnstown, Pa., is now being managed by **Robert C. Seaton** who has succeeded **William E. Austin**, retired. Mr. Seaton joined the company in 1934 and has been a salesman since 1945. Mr. Austin has been associated with the firm as a salesman and branch manager for the past 35 years. . . . **D. J. Murray Mfg. Co.**, Wausau, Wis., has announced the following as distributors of its unit heaters and allied products: **I. Ernest Shaer**, 161 Devonshire St., Boston 10; **G. T. Pottinger & Co.**, 2475 Rivers Rd., N.W., Atlanta; **Jordan Engineering Co.**, Traction Bldg., Cincinnati; **Lefler Wyomont Supply Co.**, P. O. Box 2166, Casper, Wyo.

As part of its program of expanded operation, **Redmond Co., Inc.**, Owosso, Mich., has elected five new vice presi-

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PERMANENT AS THE EARTH ITSELF

It's the modern, high-efficiency, low-cost way to insulate underground piping. It's permanent—rot-proof, fire-proof, water-proof. No encasement, tunnels, joints, cracks—*Z-Crete is a strong, solid mass of insulating concrete that won't get out of line. Ample compressive strength to withstand heavy highway loads.

Guaranteed Installation—Furnished and installed by competent, authorized applicators. Rigid supervision, constant inspection during installation. On-the-job fabrication eliminates possibility of failures due to shipping and handling.

Reasonable Cost—Size or number of pipes makes no difference. *Z-Crete can insulate any pipe arrangement at reasonable cost.

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No drilling or plugging for JOE RAMSETTER. In 30 seconds, he does the complete job of setting pins or studs to accurate positions in steel, concrete, masonry. Just load the light, portable RAMSET TOOL, press against the work and RAM! Fastener sets quicker than a wink—tightly, easily.

No electric lines or air compressors! RAMSET is self-powered, carried in one hand from job to job, always ready to set, instantly, pins and threaded studs up to 6″ long and ¼″ diameter. On continuous work, any good workman can "RAMSET" up to 50 fasteners per hour.

Ask for a 15-minute RAMSET demonstration. You'll see why it breaks all records for speed and economy on fastening jobs, pays a profit on every setting. *Stemco Corporation, Cleveland 16 (Rocky River), Ohio.*

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FASTENING SYSTEM

Stemco Corporation, HP-5
Cleveland 16 (Rocky River), Ohio
Please send details and arrange 15-minute demonstration of RAMSET FASTENING SYSTEM. No obligation, of course.

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"Your insulation* prevented the fire from spreading".

From a letter from Ralph M. Fishel & Co., Denver, Colo., insurance and private banking.

BECAUSE INFRA INSULATION

***Emits Only 3% of Heat Rays**

***Is Metal with a 1250°F Melting Point**
(Furnace Heat is Only 750°F)

***INFRA IS A REAL FIRE STOP**

Infra's surface absorbs only 3% of heat rays – 97% is rejected! Infra emits, on the opposite surface, only 3%. That is one reason why Infra is so efficient in preventing wasteful—or dangerous—heat flow. Summer or winter, Infra keeps heat in its proper place.

Infra Insulation uses 99.5% pure aluminum made in accordance with Infra's own, special emissivity specifications. The fiber partition, which creates multiple air spaces and reflective surfaces, is flame, mold, and vermin proof.

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C.052 Heat Flow Down, equals 6" Rockwool.
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Architects and engineers use it as a handbook, and colleges as a text, on heat transfer, condensation, vapor, mold, radiant heating, etc. Contains chart of *k*, C, R and U factors of all insulations, of all thicknesses, weights, densities.

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Infra INSULATION, INC.
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dents: **James Tweedy,** in charge of induction motor sales, **Paul B. Best, Jr.,** in charge of series motor sales; **James G. Kennedy,** in charge of production in Owosso; **Paul Maurer,** in charge of engineering; and **Wilfred R. Fox,** advertising manager. Mr. Fox was also recently named manager of advertising and marketing research for **Holtzer-Cabot, Inc.,** an affiliated company. **W. Walter Young** is now comptroller-treasurer, having previously been comptroller. The new officers are in addition to Executive Vice President **Lewis Hamlin** and Vice President **Glenn Baumhardt** who is the liaison between the engineering and sales departments.

Awards totalling $500 have been given to 11 employees of **Dravo Corp.,** Pittsburgh, for the best papers submitted in the company's 10th annual technical papers competition. Among the winners, **R. D. Darrah,** air conditioning engineer in the machinery division, took second prize for a paper on the air conditioning of crane cabs in steel mills and foundries. His paper has also been presented before the annual convention of the Association of Iron and Steel Engineers. . . . In line with its objective of studying and calling attention to unusual hazards before they result in accidents, the accident prevention department of the **Association of Casualty and Surety Companies** has appointed **S. Charles Rothmann** to its staff. As research engineer in the industrial division of the department he will develop a series of detailed reports on special chemical hazards.

The "Model City" program inaugurated in Columbus, Ohio, last year by the **Coal Producers Committee for Smoke Abatement** is now well under way and **Harry C. Ballman** has recently been appointed smoke regulation engineer. He has had a good deal of experience in air pollution control gained in Indianapolis and Richmond, Va. and was combustion engineer for the Island Creek Coal Co. for over 10 years. . . . Stationed in Cleveland and serving the Pittsburgh, Cleveland, and Detroit areas, **James E. Ziegler** is a new sales engineer for **Cooper Alloy Foundry Co.,** Hillside, N. J. . . . **M. V. Stagg,** formerly assistant to the vice president in charge of **Williams Oil-O-Matic Div., Eureka Williams Corp.,** Bloomington, Ill., is now assistant to the president in the division. He joined the company in 1934 as manager of its Ice-O-Matic Div. and during the war assumed duties tied in with the overall operation of the plant.

W. E. Judd has succeeded **S. E. Heymann** as general sales manager of the **South Wind Heating Equipment Div., Stewart-Warner Corp.,** Chicago. He joined the division in 1942 and throughout the war participated in aircraft heater sales and service. Mr. Heymann is now branch manager at Los Angeles. . . . **David V. Uihlein** has acquired **Banner Mfg. Co.,** Milwaukee, and is acting as executive director. Formerly known as Banner Products Co., the new organization plans to increase distribution and service of its resistance welders and brazers. **J. R. G. Harris** is handling sales in Wisconsin and other territories are being developed. **Arthur Kranitz** remains in charge of production. . . . **Mid West Sales Co.,** 111 W. Washington St., St. Louis 22, is the representative covering Missouri, southern Illinois, and western Kentucky for **Sun-Ray Burner Mfg. Co.,** Jamaica, N. Y. **M. R. Cardwell** and **John D. Gibbons** are in charge.

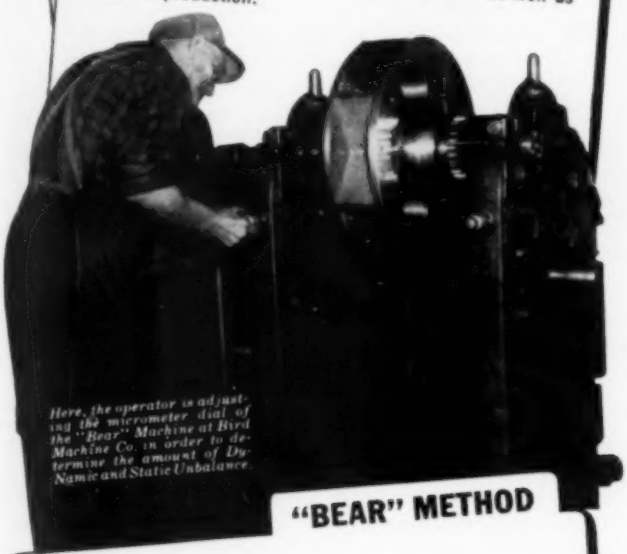
CASE REPORT No. 53 from a series of actual cases recording the successful application of "BEAR" DY-NAMIC BALANCING to Industry

High Speed Centrifugals

DY-NAMICALLY BALANCED

ACCURACY demanded for BIRD CENTRIFUGAL FILTERS

BIRD MACHINE CO., SOUTH WALPOLE, MASS., reports: "Bird Centrifugal Filters are used in practically every industry where it is necessary to separate solids from liquids. These machines can handle solids as fine as a fraction of a micron, or tonnages as high as 60 tons per hour . . . they must be precision-built. All rotating parts are Dy-Namically Balanced on our 'Bear' Machine Model 400-R. In some parts up to 25 lbs. of unbalance are indicated, but the 'Bear' Machine attains both Dy-Namic and Static Balance in one quick, simple operation. Using the 'Bear' Method, we obtain accurate results as well as efficient production."



Here, the operator is adjusting the micrometer dial of the "Bear" Machine at Bird Machine Co. in order to determine the amount of Dy-Namic and Static Unbalance.

"BEAR" METHOD

- Improves Performance
- Speeds Up Production
- Sells MORE of YOUR Products

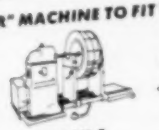
The "Bear" Method of Dy-Namic Balancing is making its weight felt in every phase of industry by helping to increase sales appeal and adding value to hundreds of products . . . from tiny electric motors to washing machines and railroad wheels. By the revolutionary "Bear" Method, both Dy-Namic and Static Balance are attained in one time-saving, efficient operation. The Dy-Namic Balancing operation need not interrupt or slow down routine production and may be installed with low initial capital investment.

Investigate the many production advantages and sales gains made possible by "Bear" Dy-Namic Balancing—

GET ALL FACTS in this FREE 22-pg. DY-NAMIC BALANCING MANUAL. Write "Bear" Mfg. Co., Dept. H-16, Rock Island, Ill.

THERE'S A "BEAR" MACHINE TO FIT YOUR NEEDS!

Model 337-V Max. Capacity 6 lbs.



Model 340-R Max. Capacity 100 lbs.

Model 375-R Max. Capacity 2,000 lbs.

(See Dy-Namic Balancing Manual for other models)

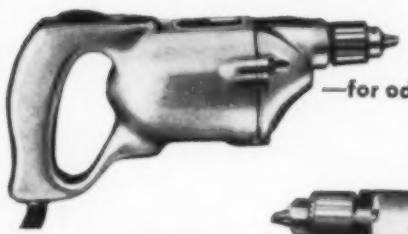
9881

"BEAR" STATIC AND DY-NAMIC BALANCING MACHINES

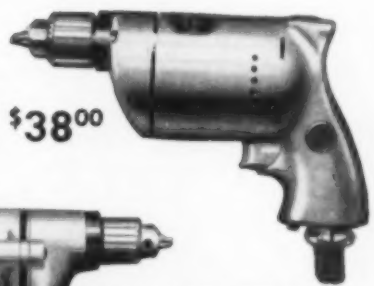
Trade Mark Registered U. S. Patent Office

for Better, Low-Cost Drilling—

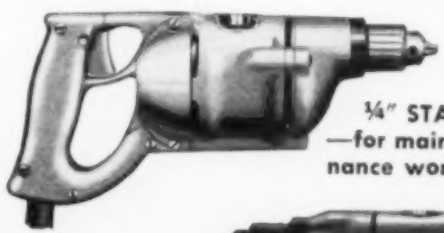
buy your DRILLS to fit your JOBS!



¼" JUNIOR DRILL —for odd-job use $28.00



¼" HOLGUN*— for light gage metal assembly..... $38.00



¼" STANDARD DRILL —for maintenance work... $44.00

¼" HEAVY-DUTY DRILL —for continuous drilling..... $50.00

BUY Black & Decker Electric Drills—and you're sure to get the *right* Drill for *every* job! Nowhere else can you find the wide selection of models (25 in all, from ¼" to 1¼" capacity)—the unmatched quality that means extra years of service—famous full-power B&D-built motors that *can't be* stalled! For example, Black & Decker builds not *one,* but FOUR ¼" Drills—each designed for particular jobs. Call your nearby B&D Distributor today for free demonstrations of the many Black & Decker Portable Electric Tools, *the world's most complete line!* Write for free catalog to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

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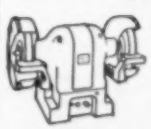

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It's "Factory Mutual Approved," meaning that it has passed very rigid tests as to tight seating and reliability of operation!

This ASCO Safety Shut-off Valve is designed to protect personnel and apparatus heated by gas for it provides a sure automatic cut-off of the flow of gas to the burner should something go wrong necessitating instant shut-down. On failure of energizing current it closes instantly and remains closed until the current is restored *and* it is opened manually. The safety function is automatic; restoration to service is manual!

If you are operating or designing gas burners or gas-fired equipment, you will be interested in the full details of ASCO "Factory Mutual Approved" Safety Shut-off Solenoid Valves. Write us. If you are interested in other automatic flow control of gas or liquids, we have many other types of solenoid valves.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

389 LAKESIDE AVENUE · ORANGE, NEW JERSEY

The **National Association of Refrigeration Contractors** has added another local association to its membership roster—the **Air Conditioning & Refrigerating Association of Florida.** Headquarters of the local group are in Miami and officers are: **Paul E. White,** president; **R. Ernest Nitzsche,** vice president, and **Harry C. Higgins,** treasurer. . . . **Manning, Maxwell & Moore, Inc.,** Bridgeport, Conn., has stationed **John C. Leitch,** valve specialist, in Atlanta to provide sales and service coverage in the southeastern territory. He was formerly associated with two subsidiaries of United States Steel Co., National Tube Co. and Columbia Steel Co., and was also with Babcock & Wilcox Tube Co.

Giffels & Vallet, Inc. and **L. Rossetti,** of Detroit, associated engineers and architects specializing in industrial plant work, have sent a representative to the Orient and to Europe to survey problems of industrialization and reconstruction. The representative is **Edward X. Tuttle,** director of foreign operations of the corporation and of its eastern division in New York. . . . **R. E. Kenney,** Minneapolis, has a background in the refrigeration field which includes four years as a service dealer and four years as zone service manager for Nash-Kelvinator Sales Corp. He has also been associated with manufacturers as a sales representative. He was recently named midwest sales representative for **Kold-Hold Mfg. Co.,** Lansing, Mich. . . . **Clifford M. Lewis,** who served two terms as director of the Stoker Manufacturers Association, is the new sales promotion manager of **Canton Stoker Corp.,** Canton, Ohio. For 10 years he was a heating engineer with the Kansas City Coal Service Institute, and prior to joining the Canton organization last year, was manager of Anchor Stove and Range Co.

T. Hollister Mabley is vice president and general manager of **Mechanical Heat & Cold, Inc.,** Detroit contractor for heating, refrigerating, and air conditioning equipment. In his new capacity he is supervising **Temp-Matic Wholesalers,** the firm's heating distributing organization, and is also serving as treasurer of the company. He became associated with the company in 1936 . . . **Wilson & Co., Inc.,** Chicago, has promoted **John G. Wilsey** to manager of hair filter sales, a subdivision of the firm's hair products division. He joined the filter staff last year, coming from Winchester Repeating Arms Co.'s electrical division. He has been associated with the heating and ventilating industry for many years.

Approves Simplified Practices for Conditioning, Warm Air Heating

Simplified Practice Recommendation R207-49, Pipes, Ducts, and Fittings for Warm Air Heating and Air Conditioning, has been approved for promulgation. The recommendation was originally issued in 1945 and established a stock list of pipes, ducts, and fittings. The new revision adds sketches and dimensions for four types of take-off fittings for extended plenum systems.

Until printed copies are available, mimeographed copies may be obtained without charge from the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

Whether you've ever used "K" fittings or not, we ask you to pick one up and examine it closely. Notice the smooth walls inside and out. Notice the clean, sharp threads and chamfered entrances.

You can tell by looking at a "K" fitting that it's sound and symmetrical. If you sawed it in two, you'd find the walls of even thickness; the entire casting close-grained and free of defects.

Over the last sixty-odd years, "K" fittings have earned an enviable reputation for their fine quality of workmanship and material. They're the kind of fittings you like to install because they make up easily and stand up indefinitely. Specify them when you order.

THE 3000 SHAPES AND SIZES OF "K" CAST-IRON FITTINGS INCLUDE:
STANDARD AND EXTRA HEAVY SCREWED FITTINGS
STANDARD FLANGED FITTINGS
STANDARD AND EXTRA HEAVY COMPANION FLANGES
DRAINAGE AND SPRINKLER FITTINGS

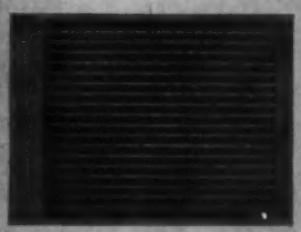
K PRECISION FITTINGS

KUHNS BROTHERS CO.
DAYTON 1, OHIO

COMBINED MARKET FACILITIES with Malleable Iron Fittings Company, Branford, Conn., and Kuhns Bros. Co., Dayton, Ohio

McCORD
HEATING AND AIR CONDITIONING PRODUCTS

BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallicaBy bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

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A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

Save fuel with McCord Unit Heaters.

McCord CORPORATION
DETROIT 11, MICH.

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ON ICE!

Rooms will be up to 15° COOLER with KOOLSHADE Sun Screen

KoolShade on 100 square feet of sun-exposed window has the cooling effect of a ton of ice each day.

Folks work better when they are comfortably cool. Production goes up—costs go down. KoolShade is like a miniature venetian blind blocking the hot rays of the sun *outside* the windows. It does this without blocking air, light or vision.

And there is a definite reduction of heat load which materially reduces the cost of operating air-conditioning equipment. Hundreds of the largest organizations in the country have approved KoolShade for use on all sun-exposed windows. Mail the coupon today for free sample and literature.

KOOLSHADE BENEFITS YOU IN THESE WAYS

Low maintenance cost—no painting . . . no fire or wind hazard . . . long-lasting . . . prevents sun-fading of furnishings . . . excellent insect protection . . . easy and inexpensive to install.

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Provides Excellent Summary of Industrial Hygiene

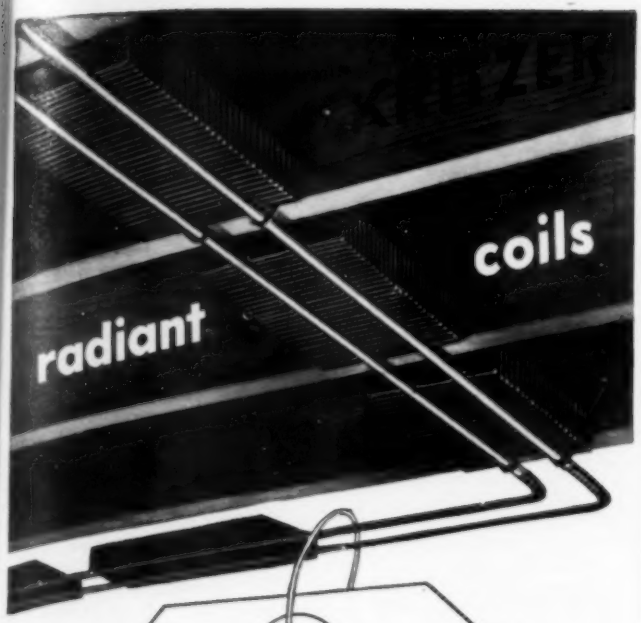
Industrial Hygiene and Toxicology is a worthwhile addition to the library of all engaged in industrial hygiene and industrial ventilation and should be interesting to others. Chapter I furnishes an excellent summary of this subject—past, present, and probable future—which is recommended reading for everyone.

This is the first volume of a comprehensive two-volume treatise prepared by a group of specialists under the editorship of Frank A. Patty, director, industrial hygiene service, General Motors Corp. It is the object of this book "to present industrial hygiene and toxicology in simple, understandable terms in sufficient detail to be of some use to all persons interested in safeguarding the health and welfare of working people and in improving the working environment." The field of industrial hygiene encompasses so many professional skills that no one individual perhaps can be expert in all. For this reason, the editor chose to have many contributors, who are experts in their respective spheres of professional activity, assist in the preparation of the book.

Vol. 1 is composed of 15 chapters written by 11 authors. Vol. II which will be published in the near future contains 20 chapters written by eight authors, several of whom are contributors to Vol. I. The chapters of the first volume deal with:

Industrial Hygiene—Retrospect and Prospect, by Frank A. Patty, General Motors Corp.
Industrial Hygiene Records and Reports, by John B. Littlefield, American Brake Shoe Co.
The Industrial Hygiene Survey and Personnel, by Frank A. Patty.
Personal Factors in Competence and Fatigue, by Josef Brozek, University of Minnesota.
Environmental Factors in Fatigue and Competence, by W. N. Witheridge, General Motors Corp.
Physiological Effects of Abnormal Atmospheric Pressure, by Heinz Specht, National Institute of Health
The Mode of Entry and Action of Toxic Material, by Frank A. Patty
Sampling and Analysis of Atmospheric Contaminants, by Frank A. Patty
Radiant Energy and Radium, by Leon F. Curtiss, United States Bureau of Standards
Ventilation, by W. N. Witheridge
Occupational Dermatoses, by Louis Schwartz, consultant
The Visible Marks of Occupation and Occupational Diseases, by Carey P. McCord, Industrial Health Conservancy Laboratories
Fire and Explosion Hazards of Combustible Gases and Vapors, by G. W. Jones, United States Bureau of Mines
Explosion and Fire Hazards of Combustible Dusts, by Irving Hartmann, United States Bureau of Mines
Respirators and Respiratory Protective Devices, by Frank A. Patty
Dust and Its Role in the Causation of Occupational Disease, by Edward E. Dart, Pacific Industrial Hygiene Laboratories

The chapter on ventilation obviously is of greatest interest to HPAC readers, although several of the others hold special interest for all engaged in industrial ventilation. In his treatment of ventilation, Mr. Witheridge discusses seven major subdivisions of the general subject, restricting the contents to industrial ventilation. The particular topics discussed are: (1) human ventilation requirements, the composition of air, amount needed, and the like; (2) general industrial ventilation, with specific reference to types, terminology, amount required for contaminant control, make-up air, heat loss, and short circuiting; (3) industrial process ventilation with respect to the prevention of escape of industrial atmospheric con-



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				NO. OF COILS	SHIP. WT. APP.	
12" O.C.	8"	4"	120½"	8	125 lb.	80⅓'
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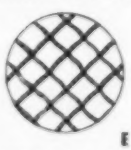

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taminants into the workroom air by enclosures and local hoods; (4) air cleaning methods and equipment with special reference to the functioning of different types of cleaners or collectors, selection of proper cleaners and recirculation of filtered air; (5) aeromotive methods and equipment, with discussions of the different methods of moving air such as roof ventilators, thermal head, fans, and ejectors; (6) duct design with attention to all the usual phases including materials, construction specifications, and maintenance; and (7) air flow observation and measurement, covering visible, static and dynamic, chemical, thermal, and electrothermal procedures.

Containing 531 + xxvii pp., 6½ x 9¾ in., Vol. I is available from Interscience Publishers, Inc., 215 Fourth Ave., New York 3, at $10.00—Reviewed by Allen D. Brandt, industrial hygiene engineer, Bethlehem Steel Co.

Many Factors and Applications of Air Conditioning Described at Texas Conference

The Fourth Annual Air Conditioning Conference, held last year at the A. & M. College of Texas, was sponsored by the department of mechanical engineering of the college, in cooperation with the Texas chapters of the American Society of Heating and Ventilating Engineers and the air conditioning and related industries of Texas.

Some 14 technical papers were presented and are included in the proceedings of this three day meeting which opened with a talk by F. E. Giesecke, consulting engineer, former national president of ASHVE, and member of HPAC's board of consulting and contributing editors. After tracing early developments of air conditioning, he mentioned some of the little-understood problems which remain to be solved and called attention to the fact that the science of air conditioning is not yet a closed book.

Technical papers presented include:

Correct Design Conditions for Southwest and West of Mississippi River, by Dale S. Cooper, Dale S. Cooper and Associates

Air Conditioning Research Opportunities in the Southwest, by Carl F. Boester, director housing research, Purdue University

The Heat Pump to Date, by Donald M. Vestal, assistant research engineer, Texas Engineering Experiment Station

Economic Balance Between Coil and Compressor Capacity for Air Conditioning, by D. C. Pfeiffer, professor of mechanical engineering, Southern Methodist University

Development of the Absorption Refrigeration and Air Conditioning System, by Dr. Norton E. Berry, Servel, Inc.

Chemical Dehumidification, by Joe K. Hawk, F. J. Evans Co.

The Regenchil System of Air Conditioning, by C. S. Bauman, Tex-Air Conditioning Co.

The Venting of Modern Gas Appliances, by Arthur Theobald, chief engineer, Payne Furnace Co.

The Economic Philosophy of the Professional Engineer, by Dr. E. E. Rosaire, president, San Jacinto Chapter, Texas Society of Professional Engineers

Cooling Tower Performance for Air Conditioning Systems, by J. F. Moss, York Corp.

Modern Automatic Controls, by Charles C. Quin, Powers Regulator Co.

We Too Have an Interest, by Paul F. Woolrich and Martin C. Wukasch, engineers, Industrial Hygiene Section, State Health Dept., Austin, Tex.

Operating Your Business Under a Set of Modern City Codes and Rigid Inspection, by A. B. Wicks, director, Dept. of Building Safety, Los Angeles

The Importance of Air Measurement, by W. J. Bailey, applications engineer, Illinois Testing Laboratories

The proceedings are in the form of a 150 page, 6 x 9 in. printed booklet which is paper covered and is identified as Bulletin No. 110 of the Texas Engineering Experiment Station, Agricultural and Mechanical College of Texas, College Station, Tex.

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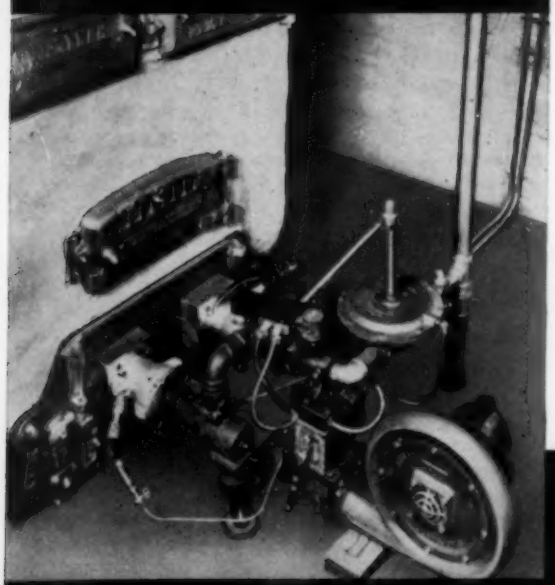

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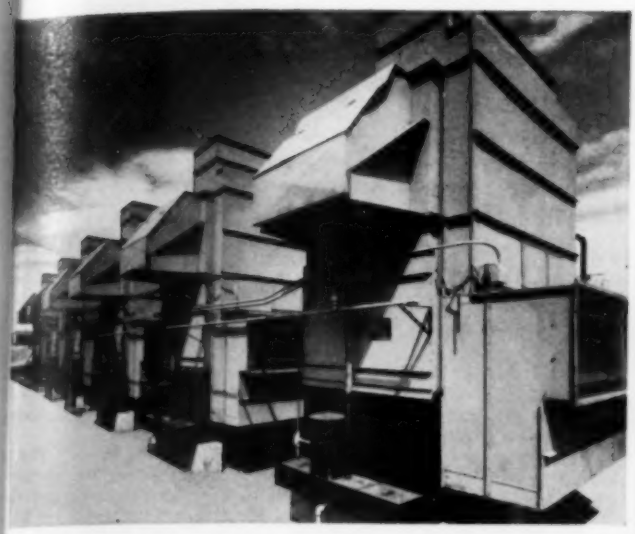

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5710	5065	4210	2185	⅛	240L
5490	4640	4385	3045	½	240P
6960	6480	6010	4810	¾	240Q
8520	8100	7375	6075	1½	240S
7545	6875	6100	4080	½	270N
9150	8425	7950	5950	1	270Q
11600	10750	10150	8875	2	270U
10200	8925	7750	2075	¾	320E
11225	10330	9025	5765	1	320F
11400	9925	8125	4200	¾	360G
12200	10915	9875	6990	1	360K
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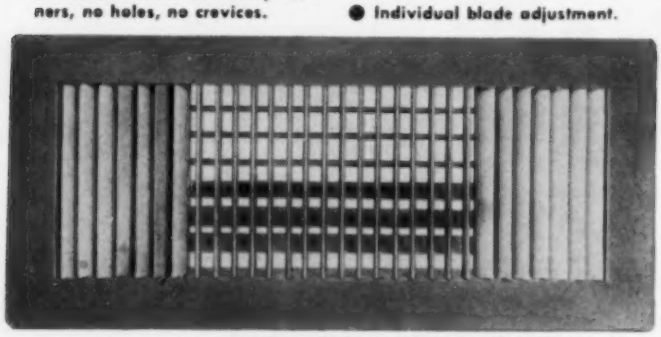

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Flanged Joints, Hydraulic Packing Among Subjects at Hydraulics Conference

The 1948 National Conference on Industrial Hydraulics was sponsored by Armour Research Foundation and the graduate school of Illinois Institute of Technology. The 12 technical papers presented deal with a variety of subjects including the automotive torque converter, hydraulic circuits on farm equipment, the application of hydraulic servomechanisms, and the measurement of servomechanism performance. Papers which should be of more direct interest to HPAC readers are:

Flanged Joints—Their Development and the Trend, by E. G. Schmitz, Crane Co.

Hydraulic Packings and Seals, by C. E. Schmitz, director of engineering, Crane Packing Co.

Gasket Design and Selection, by H. H. Dunkle, Johns-Manville Corp.

Recent Developments in Hydraulic Turbine Design and Manufacture, by J. F. Roberts, manager, hydraulic dept., Allis-Chalmers Mfg. Co.

Hydraulic Surges in Pump Discharge Lines, by S. Logan Kerr, consulting engineer, Philadelphia

Predicting Liquid Jet Pump Performance, by R. G. Folsom, professor of mechanical engineering, University of California

Vol. 2 of the complete proceedings contains these technical papers, is a 154 page, paper covered pamphlet, and is priced at $3.00. Copies may be obtained from S. F. Musselman, conference secretary, National Conference on Industrial Hydraulics, Technology Center, Chicago 16.

I-B-R Issues Installation Guides on One Pipe Hot Water Heating, Baseboard Panels

Installation Guide No. 5, issued by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17, presents a simple and economical basis for the selection and installation of baseboard heating units in one pipe, forced circulation, hot water heating systems. It also gives data on the installation of baseboards with other types of systems such as two pipe, forced circulation or gravity hot water, and two pipe steam systems.

Guide No. 100 has been issued recently and replaces Guide No. 1, on one pipe, forced circulation, hot water systems. The superseded pamphlet was restricted to buildings with heat losses up to 60,000 Btu per hr. The new guide contains details for calculating and designing systems which utilize mains from ¾ to 1½ in. It also contains data applicable to the use of either iron pipe or copper tube for mains, circuits, branches, and risers.

These new publications are available from I-B-R headquarters at 50 cents each. Calculation sheets (Form 1001-48 for use with Guide No. 100 and Form 5001-45 for use with Guide No. 5) are priced at 20 cents per pad.

Correction

The author of the paper, **Balancing Air Delivery of a System of Manifold Diffusers**, by George S. Dauphinee and Peter Argentieri, published in the April issue, p. 105, calls attention to a printer's error in Equations 4 and 5. Equation 4 should be

$$P_2 = \frac{P_1}{\left(1 - \frac{T}{100}\right)^2} \qquad (4)$$

and Equation 5 should be expressed

$$P = 2.2\left(\frac{V}{4005}\right)^2 \qquad (5)$$

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MEETINGS & CONVENTIONS

Instrument Society of America, 1117 Wolfendale St., Pittsburgh 12—The fourth annual spring meeting will be held at the Royal York hotel, Toronto, Canada, May 12 and 13. The tentative program indicates four technical sessions and a dinner.

Technical papers and panel discussions will cover such subjects as unit start-up problems, chemical process instrumentation, instrument department organization, and applications in the pulp and paper industry.

The 1949 conference and exhibit are scheduled for September 12 to 16 in St. Louis, and the 1950 convention and exhibit will be held in Buffalo, September 11 to 15.

Oil-Heat Institute of America, 6 E. 39th St., New York City—1949 national convention and National Oil-Heat Exposition, May 16 to 20. Boston. Convention headquarters will be the Statler Hotel and the exposition will be in Mechanics Hall.

On Wednesday, May 18, during the burning oils industry session, Dr. W. C. Schroeder, chief, Office of Synthetic Liquid Fuels, Bureau of Mines, will talk on heating oils from petroleum, coal, and shale. During the next day's dealer session, Dr. Courtney Brown, assistant head of the coordination economics dept. and head of the petroleum economics division, Standard Oil Co. (New Jersey), will discuss burning oils and the future. A feature of the architects and engineering day session, May 20, will be a forum on whether lower heating costs are to be realized from burners or heat absorbing vess... Henry Wright, architect and consulting engineer of Ne... York, will address the meeting on recent progress ... heating and building design.

During the convention, members of the **Old Timer... Club of the Oil Burner Industry, Inc.** will get toge...her f... their annual dinner meeting on May 17 at Coral Gable... North Weymouth (Boston's south shore).

Bituminous Coal Research, Inc., 912 Oliver Bldg., Pitts... burgh 22—1949 annual meeting, May 18, Columbus, Oh... Executives of more than 300 coal and railroad compani... will join with BCR executives and engineers to conside... the status of current projects, plans for future researc... and industry needs which can be satisfied by cooperati... research.

The many talks scheduled include a discussion of re... search for industrial uses, by V. G. Leach, chief combus... tion engineer, Peabody Coal Co., and a description o... fuel gas from coal, by J. Mitchell, director of researc... Eastern Gas and Fuel Associates.

National Steam Specialty Club—Annual meeting, Ma... 18 to 20, Skytop Lodge, Skytop, Pa. Membership of thi... organization includes executives of 75 manufacturers o... engineering specialties. Frank H. Jones, Schade Valv... Mfg. Co., 2527 N. Bodine St., Philadelphia, is secretary-treasurer.

Smoke Prevention Association of America, 72 W. Adams St., Chicago 90—42nd annual meeting, May 23 to 27, Detwiler hotel, Birmingham, Ala. In addition to various

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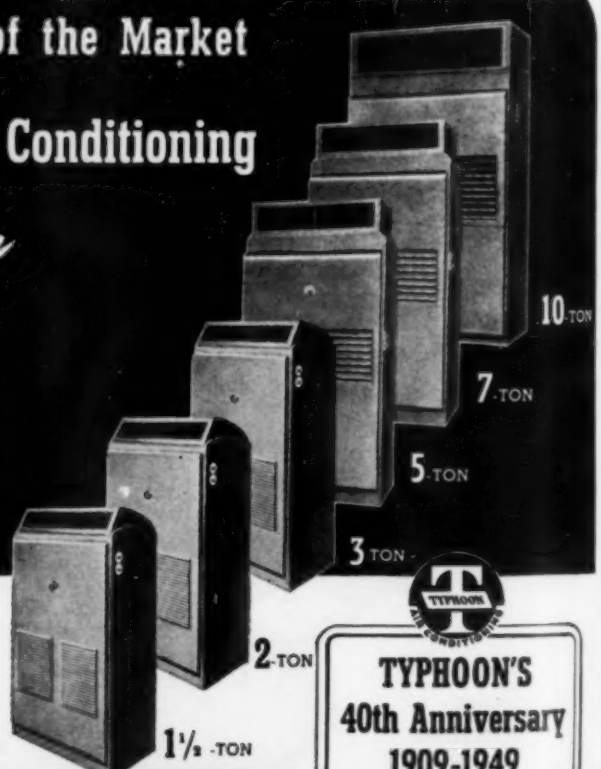

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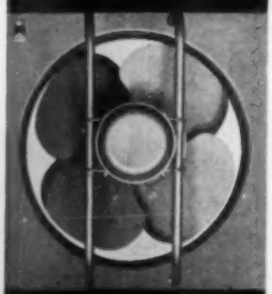

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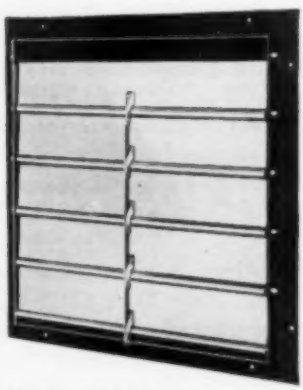

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Moisture resistance	excellent	some good, some poor
Vapor seal	simple	complicated or difficult to install
Structural strength	very good	some non-existent, others fair
Weight	very light	varies
Resilience	considerable	from fair to complete rigidity
Settling	none	a serious problem
Supporting structure	none	elaborate
Fire resistance	good	excellent to poor
Vermin resistance	good	excellent to very bad
Odor absorption	none	some are regular sponges

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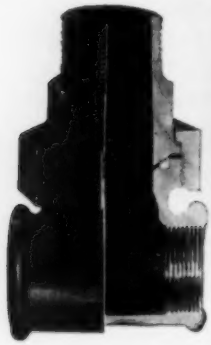

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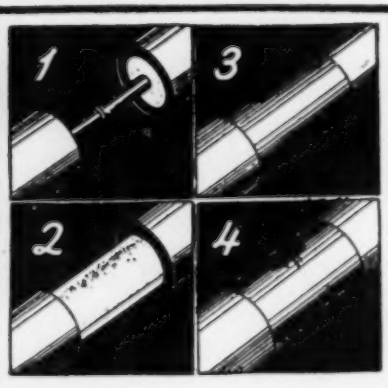

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committee meetings, there will be a panel discussion of the ASME model for smoke and dust regulation laws, and members are invited to inspect the heat pump activities at Southern Research Institute. Technical papers to be presented include:

Medical Aspects of Air Pollution, by Dr. A. J. Lanza, chairman, Institute of Industrial Medicine, New York University and associate medical director, Metropolitan Life Insurance Co.

Hot Gases From High Stacks—A Practical Means of Overcoming Objectionable Concentrations of Effluent Gases, by George R. Hill, Moyer D. Thomas, and John N. Abersold.

Smoke and Fumes Abatement in the Oil Industry, by W. L. Stewart, Jr., Western Oil & Gas Association.

Air Pollution Problems of the Steel Industry, by L. B. Patin, engineering dept., Carnegie-Illinois Steel Co.

Solid Fuel Industry's Contribution to Air Pollution Prevention, by W. S. Major, Bituminous Coal Research, Inc.

Operation of Stokers to Prevent Smoke, by Robert Milligan, combustion engineer, Crerar-Clinch Coal Co.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6—40th annual meeting, New Ocean House, Swampscott, Mass., May 24 to 27.

Food Distribution Exposition—Sponsored by the United States Wholesale Grocers Association, the first national show to be devoted to all phases of the food distribution field will be held at the St. Louis Auditorium, May 30 to June 1. Wholesalers' warehouse and office operation, store modernization, and merchandising methods will feature the business sessions. Registration cards for admission may be obtained from Clapp and Poliak, Inc., 350 Fifth Ave., New York 1, show manager.

1949 Canadian International Trade Fair, May 30 to June 10, in the Exhibition Grounds, Toronto—An integral part of the long range planning for the development of Canada's foreign trade, the fair will consist of a large number of exhibits covering 21 trade classifications. In the building materials, heating, and plumbing section air conditioning equipment and accessories will also be on display. Details may be obtained from R. M. Williams, CITF headquarters, Exhibition Grounds, Toronto.

Fourth Annual National Home and Building Exposition—June 2 to 12, Pan-Pacific Auditorium, Los Angeles. Designed to show commercial, residential, and industrial materials, products, techniques, and services, it is owned and sponsored by 13 industry associations and the Los Angeles Chamber of Commerce.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—Spring meeting, June 5 to 8, aboard ship during a cruise from Montreal on the St. Lawrence and Saguenay rivers.

With only a limited number of staterooms still available, the society is accepting reservations only for ASRE members and their immediate families. A nonmember waiting list, however, is being established for use in the event of cancellations, etc.

Heating, Piping & Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20—60th annual meeting, June 8 to 10, Hotel Statler, Detroit.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1—1949 annual meeting, French Lick Springs, Ind., June 13 and 14. The meeting will be open

NEW Water Tight, Air Tight, Corrosion-Proof Gasketing Procedures

WITH Chrome Lock

ADHESIVE BACK, CHROMATE IMPREGNATED

FELT TAPES

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Chrome Lock is a specially compounded and impregnated felt, containing zinc chromate as a corrosion inhibitor. It is widely used for flange gasketing in forced air systems, moisture sealing in spray cooling units, flue sealing and many similar installations.

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Inhibits electrolytic action between dissimilar metals. • Permits lighter flanging materials. • Anti-wicking. • Non-soluble in water or saline solutions. • Permits the use of raw sheet stock for flanges. • Protective cushion against vibration and shocks. • Will not support combustion. (Type N, Navy Spec. 33F8.) • Wide range of heat, cold and pressure resistances. • Available in rolls, tapes or stamped; 3/16" to 72" wide, 1/32" to 1/4" thick.

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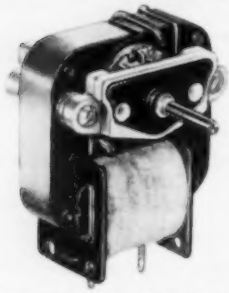

Type 230 Deluxe Model with die-cast bearing brackets.

The efficiency of Raytheon Type 230 Motors is almost double the value ordinarily obtained in shaded 2-pole motors of this size. It is typical of all Type 230 motors that the speed torque curve is unusually flat between "No Load" and "Pull Out". The Starting Torque and Pull Up Torque are likewise *unusually* high!

Better speed stability under variable operating voltages is possible with this flatter speed torque curve. The result is MORE HORSEPOWER PER POUND!

DELUXE MODEL: *for use on phonographs, wire and tape recorders, sound projectors . . .*
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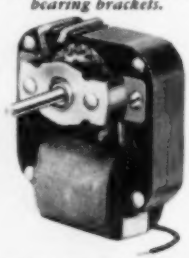
Type 230 Economy Model with brass-strap bearing brackets.



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to individuals and representatives of allied industries and organizations upon invitation.

Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17—Third I-B-R short course on steam and hot water heating, University of Illinois, Urbana, Ill., June 14 to 17. The program will consist of a number of lectures and problems covering the design of various types of systems. Both a beginners' course and an advanced course for those who attended one or both of the previous sessions will be given.

The 4th International Gas Conference, June 15 to 17, London, England—Sponsored by the International Gas Union, comprised of national gas associations throughout the world. Additional information may be obtained from the American Gas Association, 420 Lexington Ave., New York 17.

3rd Annual Store Modernization Show, June 19 to 24, Grand Central Palace, New York City—Daily conferences will be conducted under the direction of the New York University School of Retailing. Admission tickets, as well as invitations, can be obtained from the school or from the Store Modernization Institute, 40 E. 49th St., New York 17.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—1949 semi-annual meeting, June 20 to 22, Minneapolis. For details see the ASHVE Journal Section in this issue.

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—Mid-year convention, June 21 and 22, Edgewater Beach hotel, Chicago.

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.—The fifty-second annual meeting will be held at the Chalfonte-Haddon Hall hotel, Atlantic City, June 27 to July 1. The first national meeting of the society on the west coast will be held at the Fairmont hotel, San Francisco, October 10 to 14.

American Welding Society, 33 W. 39th St., New York 18—The 30th annual meeting and exposition will be held in Cleveland, the week of October 16.

As usual, the meeting will be held during the National Metal Congress and Exposition. The society has reserved a block of rooms at the Hotel Cleveland, headquarters for the meeting. When the quota is filled, room applications will be referred to the Metal Congress Housing Bureau.

2nd Biennial Pacific Chemical Exposition, November 1 to 5, San Francisco Civic Auditorium—A display of natural resources of the 11 western states is to be a featured exhibit at the show which is sponsored by the California Section, American Chemical Society, Whitcomb hotel, San Francisco 1. Marcus W. Hinson is managing the affair.

Ninth Midwest Engineering and Power Exposition—November 11 to 16, Navy Pier, Chicago. George E. Pfisterer, 308 W. Washington St., Chicago, is managing director.

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The Haney Electronic flame failure safety control panel, ready for installation, provides safe, sure and positive combustion control and will meet insurance requirements. It is so designed that the burner cannot operate unless a pilot flame of sufficient size to ignite the burner is present and the unit itself is functioning.

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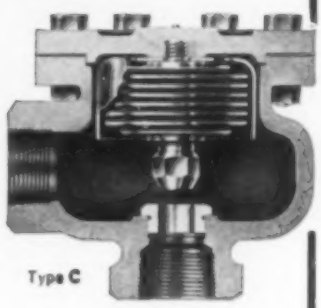

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6. NO WATER-LOGGING. Operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure.
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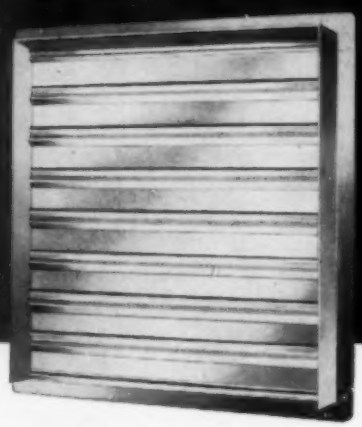

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Brownell Scotch Boilers are thrifty . . . economical to install and operate. They do not require casings, but can be easily covered with insulation. Low construction is an advantage where head room is limited. Can be used for power, processing, heating. Adaptable for oil, gas, or coal firing. Made in 12 sizes, ranging from 10 to 180 hp, 1,400 to 25,500 sq. ft. steam radiation. New bulletin just printed.

The Brownell line also includes small-capacity steel heating boilers, Standard electric-welded steel boilers, H. R. T. boilers, double-pass boilers, locomotive type boilers, vertical tubular boilers, wormfeed and ram-feed stokers, heat exchangers. You are invited to ask for literature on any or all types of Brownell equipment.

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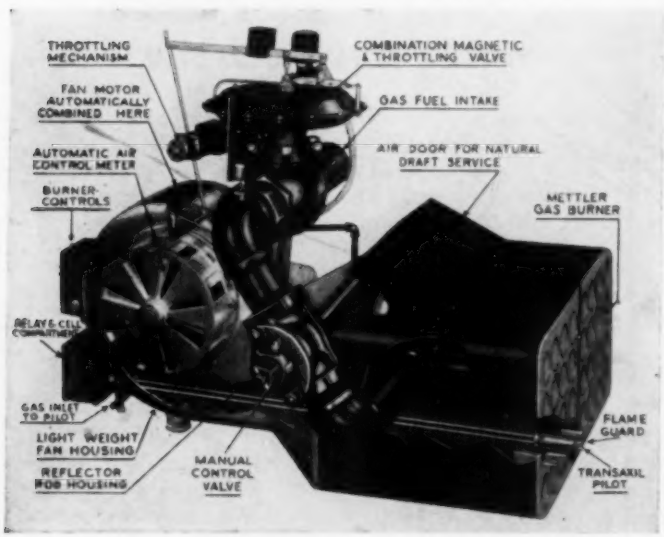

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 205. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

No. 7228: Arc Welding—The Vol. 9, No. 2 issue of Welding Time, a rotogravure news sheet type publication issued by Lincoln Electric Co., Cleveland 1, contains a number of short articles dealing with the advantages of arc welding for reducing industrial maintenance costs and for simplifying design and construction operations. The chief purpose of the publication is to present case histories and ideas on how to use arc welding effectively.

No. 7229: Boilers for Heating, Process Work—Series 4000 steel boilers are two pass, front smoke outlet, water back, Scotch marine units offered by Republic Boiler Corp., 30 Church St., New York 7. Detailed information on these units, of 25 to 360 hp, is contained in a four page folder. They are designed for 125, 150, and 200 psi working pressures and are recommended for power, process and heating applications. A new single sheet bulletin covers the company's series V, full length tube vertical boilers recommended for use by dairies, dry cleaners, clothing manufacturers, canning factories, etc. These are designed for 100, 125, and 150 psi working pressures and are available in sizes from 4 to 200 hp. Portable updraft steel firebox boilers, series WF, for low pressure heating and in sizes from 2200 to 51,000 sq ft of steam radiation are covered in another leaflet.

No. 7230: Cast Iron Convectors—How the installation of "Aero" cast iron convectors, concealed by sheet steel enclosures, produces both convected and radiant heat is explained and illustrated in an eight page bulletin (No. 540) available from National Radiator Co., Johnstown, Pa. Designed for use with one pipe steam, hot water, vapor, and vacuum heating systems, the convectors have fins cast integral with tubes and are said to have a low radiation loss through walls. Dimensions, connection data, ratings, and roughing-in measurements are given.

No. 7231: Characteristics of Copper and Brass—A 60 page booklet on the fundamental characteristics of its metals has been issued by Revere Copper and Brass, Inc., 230 Park Ave., New York 17. Basic technology of copper, brass, and bronze is given in nontechnical language. Originally prepared for distribution to employees and sales representatives, it is now available to production and technical personnel in other companies, and to teachers, technical schools, and colleges. Among the topics discussed are cold working and hardness, annealing, corrosion, and specifications.

No. 7232: Cooling Tower Operation—A series of quiz sheets, issued by Marley Co., Inc., Kansas City 15, Kan., provides general information on cooling towers and highlights the features of the company's line. No. 4 in the series is devoted to operation and deals with such factors as recommended pH values, the control of algae, preventive maintenance, and cold weather operation.

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Elimination of nuisance smoke, fly ash, and air pollution with a minimum fuel reduction of 5% is GUARANTEED on a money back basis. Investigate this new Delta "Cateicaf" scientific process of Combustion Promotion!

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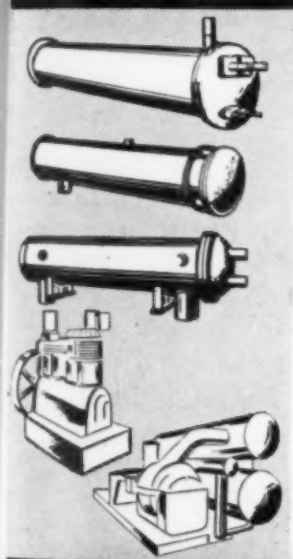

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The FYRITE Service Kit provides a complete set of accurate, quality-built combustion-testing instruments at the lowest cost. It contains the FYRITE, the heating trade's favorite CO_2 indicator; the popular DRAFTRITE Draft Gauge; and a 950° F. Stack Thermometer—all packed in a sturdy metal carrying case, with instructions and the Fire Efficiency Finder. This unique slide rule gives heating efficiency and dollars of fuel saved without calculations or reference to charts.

Instrument-testing will convince the most skeptical prospect that it will pay to follow your recommendations to replace or modernize his heating plant. For example, a Chicago dealer sold 68 burners and $50,000.00 worth of equipment and repairs by making heating efficiency tests. Another dealer, in a small Pennsylvania town, checked 43 heating installations and sold 10 complete replacements by using instruments to demonstrate the heating inefficiencies of existing equipment.

Dealer's net price of FYRITE Service Kit — $38.00 complete, with the TEMPOINT All-Metal Thermometer illustrated; or $36.50 complete, with mercury-in-glass thermometer.

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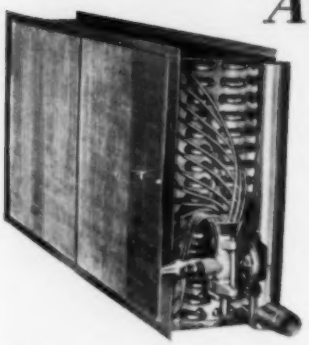

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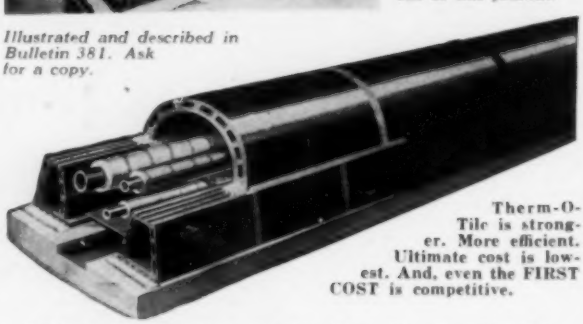

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No. 7233: Electric Motors, Transformers, and Industrial Brakes—Wagner Electric Corp., 6491 Plymouth Ave., St. Louis 14, has introduced a new publication which is being mailed to industrial concerns on a bi-monthly basis. The objective of the bulletin is to describe the firm's electrical products. The February issue features a short description of a 200 hp explosionproof, polyphase motor.

No. 7234: Flexible Metal Hose, Bellows, Expansion Joints—A new illustrated catalog (No. G-50) has been issued by Chicago Metal Hose Corp., Maywood, Ill. The 68 page booklet contains descriptions and specifications for the firm's standard types of flexible metal hose in a variety of metals. In addition, it contains sections on expansion joints for piping systems, stainless steel and brass bellows, and various conduits and special assemblies for these components. Copies of the catalog are available to those who have a direct interest and who indicate their company affiliation and title or function.

No. 7235: Flexible Ventilating Hose—American Ventilating Hose Co., 15 Park Row, New York 7, has published a 12 page bulletin (No. 30) on its lightweight flexible hose products designed for many industrial ventilating applications including fume and dust control. Among the products described are: "Flexhaust," a spiral wire reinforced hose made of neoprene compounds and cotton fabrics; "Portovent," a similar hose but having ring reinforcements to permit compression of the hose; and "Bloflex," a collapsible coated fabric hose for blowing only.

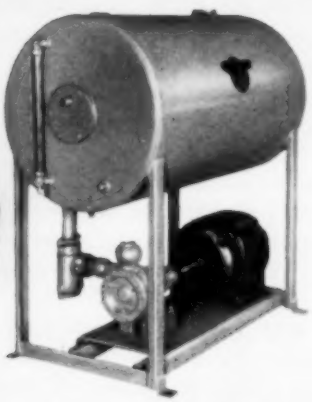
No. 7236: Flow Meters—Eight pages of photographs showing the various steps in making Hays-Cochrane electrical and mechanical flow meters are contained in Bulletin 800, released by Penn Industrial Instrument Corp., 3116 N. 17th St., Philadelphia 32.

No. 7237: Forged Steel Relief Valves and Strainers—Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co., East Chicago, Ind., has issued two new bulletins. Information on dimensions, weights, design details, and correct installation of forged steel relief valves is featured in Bulletin 711. These valves are designed for a basic steam, oil, or vapor working pressure of 600 psi at 850 F, but can be furnished with special carbon springs for more severe conditions. Bulletin 712 covers forged steel strainers which have an ASA rating of 600 psi at 850 F for steam, water, oil, or vapor, and a hydraulic rating of 1440 psi at 100 F.

No. 7238: Heating, Ventilating, Air Conditioning Equipment—The Vol. 13, No. 1 issue of Weather Magic, the organ of The Trane Co., La Crosse, Wis., pictorially describes the products, facilities, and personnel of the company. The purpose of this issue is to show how products are developed, fabricated and sold.

No. 7239: High Pressure Steam Fan Heater—In Bulletin 109 a diagram in color, photographs, and descriptive material cover the operation of the unit offered by Niagara Blower Co., 405 Lexington Ave., New York 17. A dual coil system is installed in a standard fan heater so that high pressure steam is condensed in the upper finned coil.

ROTH HEAVY DUTY BOILER FEED UNITS



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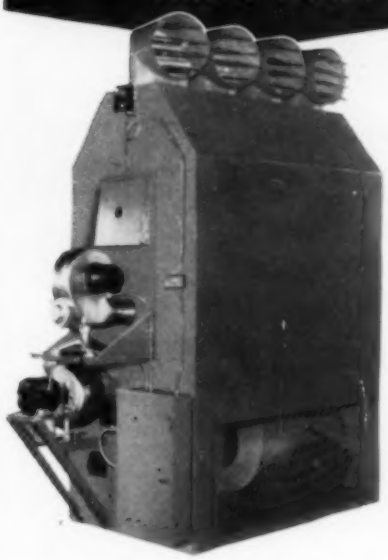

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Olson offers a compact unit designed to deliver up to 85% efficiency. Low in first cost and economical in fuel consumption, the Olson is also the most easily serviced heater in use. All vital parts are accessible without dismantling the unit.

The Olson heater is designed to heat adequately any size building. Capacities range from 300,000 to 6,000,000 BTU. Unit may be operated on gas, oil, or coal. Write for our catalog BE-848.

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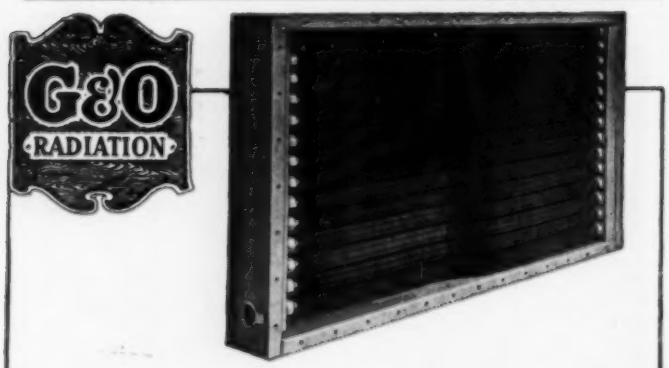

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No. 7240: Hose Couplings and Clamps, Air Valves, a Manifolds—Condensed Catalog No. 149 has been issue by Hose Accessories Co., 17th St. & Lehigh Ave., Phila delphia 32. The firm's complete line of "Le-Hi" hos couplings, hose clamps, air valves, and manifolds a covered.

A universal coupling with self locking springs is fea tured and descriptions of throttle valves for compresse air service, air hammer hose couplings, special hig pressure couplings, and various other types are include

No. 7241: Industrial Applications of Adsorption Dryin—Bulletin 216, issued by Pittsburgh Lectrodryer Corp P. O. Box 1766 Pittsburgh 30, briefly describes the prin ciples of drying by adsorption and pictorially cover numerous industrial case histories showing installations o the company's dehumidifying machines employing act vated alumina.

No. 7242: Industrial Turbines—A new 20 page booklet B-3896, released by Westinghouse Electric Corp., P. O Box 868, Pittsburgh 30, contains basic information on type E industrial turbines. Cutaway views show operating features and general construction. Various wheel sizes are enumerated and a guide is given to aid in the selection of the proper unit for steam conditions and type of load Detailed descriptions of parts and accessories are included

No. 7243: Instruments for Industrial Waste Disposal—Bristol Co., Waterbury 91, Conn., has published Bulletin 138 on industrial waste disposal. Applications of the company's automatic pH recording and controlling instruments and recording flowmeters are covered. Included are illustrations of instruments and diagrams of several typical waste disposal applications.

No. 7244: Preplated Metals—A handy index to preplated metals in the form of a "sampler" and file folder is available from American Nickeloid Co., Peru, Ill. The four page folder contains samples of metals finished in chrome, copper, nickel, and brass—available on zinc, steel, copper, brass, and aluminum bases. In addition to actual samples in bright and satin finishes, striped and crimped designs, data are given on the sizes of sheets, coils, and flat strips offered. Information is also given on gages, tempers, finishes, and properties of metals, together with protective coatings and tints.

No. 7245: Pumps, Radiation, Unit Heaters, Steam Specialties—C. A. Dunham Co., 400 W. Madison St., Chicago 6, has published a new and condensed version of its general products catalog. Containing 12 pages, Bulletin 634B covers three types of unit heaters, cabinet convectors, baseboard convectors, finned radiation, pumps, and steam specialties. Some 36 different products are discussed and specifications, capacities, and applications are covered.

No. 7246: Refrigeration Thermal Expansion Valve—Peerless of America, Inc., 2901 Lawrence Ave., Chicago 25, has issued a new folder on its redesigned thermal expan-

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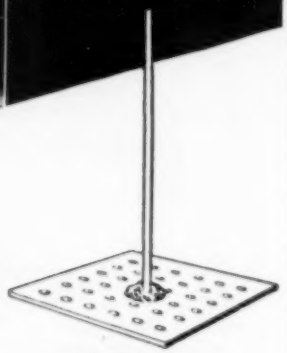

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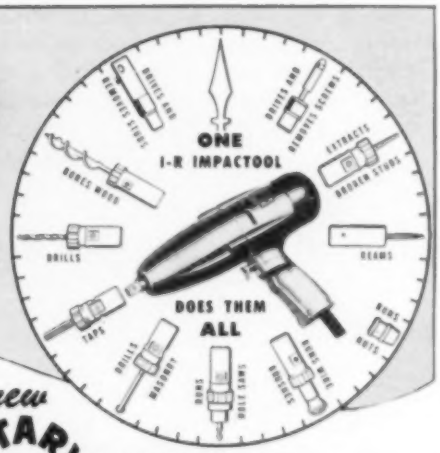

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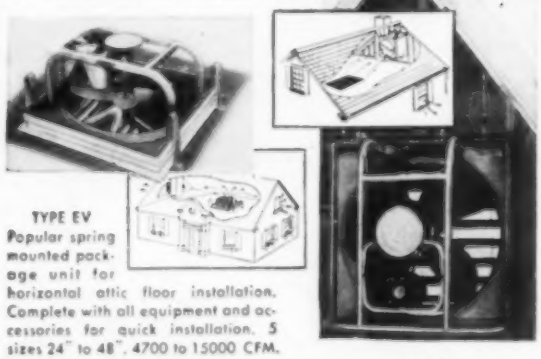

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No. 7247: Room Air Conditioners—Illustrations and brief descriptions of various room air conditioners offered by Remington Air Conditioning Div., Remington Corp., Cortland, N. Y., are contained in Bulletin G-2. Advantages of these units, together with a discussion of the merits of both air and water cooled models, are featured.

No. 7248: Self Cleaning Air Filters—A new eight page bulletin released by Dollinger Corp., 11 Centre Park, Rochester 3, N. Y., covers the model A-3 "Staynew" ventilation filter which is of the automatic self cleaning type. Unusually high efficiency and exceptionally large dust handling capacity are among the numerous advantages cited. Detailed information given includes a capacity chart (based on a normal rated air velocity of 500 fpm) listing sizes from 3150 to 153,650 cfm.

No. 7249: Shaded Pole Motor—A new three color bulletin (No. 4000) on the "Raytheon" type 470 six pole motor has been issued by Russell Electric Co., 4501 S. Western Blvd., Chicago 9. Design and construction features of this shaded pole motor (1/30 to 1/8 hp) are covered and performance curves are included.

No. 7250: Shielded Electrodes for Welding Cast Iron—Recommendations and procedures for applying "Ferroweld" and "Softweld" shielded electrodes are given in bulletin 465 issued by Lincoln Electric Co., Cleveland.

No. 7251: Silicone Oils—General Electric Co.'s chemical dept., Pittsfield, Mass., has issued a booklet describing all nine of its silicone fluids which are recommended for use as mold release agents, damping media, motor lubricants, manometer liquids, and for other applications requiring fluids with low flow points, high temperature stability and minimum viscosity changes. Included in the publication is a viscosity-temperature chart for each grade, as well as data on expansion coefficients, refraction indices, specific gravities, and other properties.

No. 7252: Small Cartridge Type Water Demineralizer—A folder issued by A. E. Tomkin & Co., 1828 Columbia Rd., N.W., Washington 9, D. C., describes the "Hydrion" water demineralizer. Said to be a "practical and simple means of converting ordinary tap water to the purity of distilled water," it is an ion exchange unit in the form of a small cartridge which is attached to any water faucet. When exhausted, the cartridge is replaced.

No. 7253: Small D-C Motor—The type J "Micromotor", a 1/10 hp, d-c unit recommended for electro-mechanical and electro-hydraulic devices, is described and illustrated in a new four page bulletin issued by Redmond Co., Inc., Owosso, Mich.

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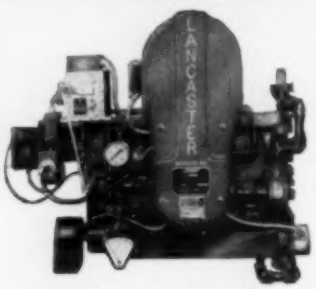

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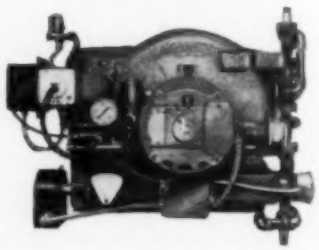
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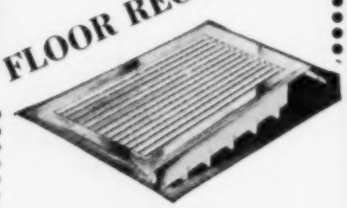

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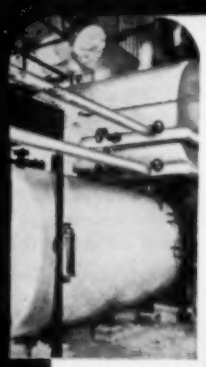

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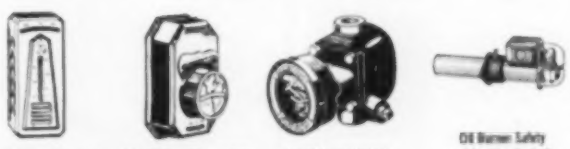

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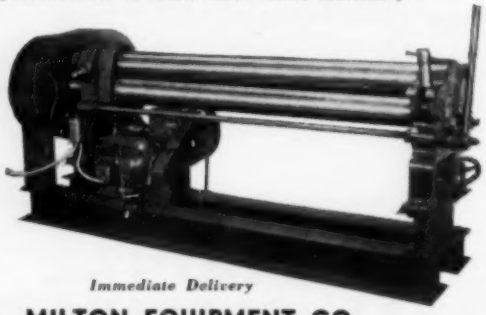

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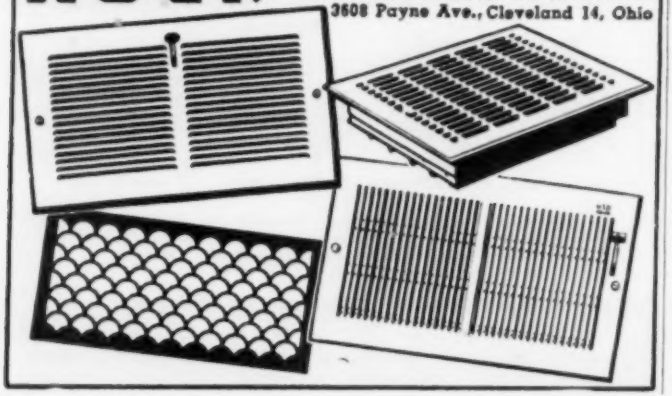

No. 7254: Sonic Generator—The model U-4 gas phase sonic generator is designed to produce sound waves at frequencies which may be varied from 500 to 22,000 cycles per second, intensity levels up to 165 decibels, and an output of over 300 watts. In addition to describing the generator, a new four page bulletin tells how it may be used as a research tool in many fields and how it is being used to generate sonic energy for dust and mist collection. The manufacturer is Ultrasonic Corp., 61 Rogers St., Cambridge 42, Mass.

No. 7255: Stainless Steel Castings—Newscast is the title of a new periodical published by Cooper Alloy Foundry Co., Bloy St. & Ramsey Ave., Hillside, N. J. Application stories depicting how the firm's castings serve industry as well as technical data about these alloys are featured. In the March 1949 issue, the leadoff article describes the alloy diffusers for Peabody Engineering Corp. oil burners.

No. 7256: Steel Boilers for Heating, Power, and Process Steam—General Catalog No. 80, Edition 80N is now off the press and available from Kewanee Boiler Corp., Kewanee, Ill. The 23 page booklet gives detailed information on low pressure boilers, high pressure units, storage water heaters, "Tabasco" water heaters, and hot water coils. A wide variety of types and sizes is covered and dimensions, ratings, and specifications are tabulated.

No. 7257: Steel Heating Boilers—The "low water line series" for use with oil, gas, and hand or stoker fired coal is described and illustrated in a four page booklet issued by Republic Boiler Corp., 30 Church St., New York 7. Dimensions, ratings, and other data are given for these units which are designed for loads of 1800 to 42,500 sq ft of steam. Similar information is given in another four page bulletin on all-welded scotch boilers for low pressure heating, series 9000.

No. 7258: Stud Welding Gun—Twenty-four picture paragraphs covering as many uses of its stud welding gun are included in an eight page booklet published by Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio. Featuring manufacturing and construction uses, the booklet covers production units and special studs.

No. 7259: Unit Heaters—Appearance, construction, performance, and applications are the subject of Bulletin 638A, released by C. A. Dunham Co., 400 W. Madison St., Chicago 6. Produced in two colors and containing 14 pages, the booklet includes 10 capacity tables.

No. 7260: Vibration Control Characteristics of Cork—Typical installations in which cork may be used to control transmission of vibration and noise, installation data, and information on specification writing are given in a new illustrated bulletin, C-1, released by Korfund Co., Inc., 48-35-G 32nd Pl., Long Island City 1, N. Y. Five cork forms are listed and described. Static load ranges for each form vary from 400 to 30,000 lb per sq ft.

No. 7261: Welding Wheels—Machine Design Application Sheet No. 103, issued by Lincoln Electric Co., Cleveland 1, gives examples of arc welding in the fabrication of wheels, gear blanks, pulleys, and flywheels.